ORIGINAL ARTICLE

TJG
The Turkish Journal of Gastroenterology

Pneumonia and mortality after percutaneous endoscopic gastrostomy insertion

Neville AZZOPARDI[1], Pierre ELLUL

Department of Gastroenterology, Mater dei Hospital, Tal Qroqq, Malta

Background/aims: *Percutaneous endoscopic gastrostomy feeding provides enteral nutrition to patients with neurological dysphagia. Thirty-day mortality rates of 4-26% have been reported, with pneumonia being the common cause post-percutaneous endoscopic gastrostomy insertion.* ***Materials and Methods:*** *This retrospective analysis of percutaneous endoscopic gastrostomy tube insertions in Malta (January 2008 - June 2010) compares the incidence of pneumonia in patients fed through a nasogastric tube versus in those fed via a percutaneous endoscopic gastrostomy tube. We analyzed the indications, poor prognostic factors and mortality for percutaneous endoscopic gastrostomy insertion.* ***Results:*** *Ninety-seven patients underwent percutaneous endoscopic gastrostomy insertion. Fifty-four patients received nasogastric feeds before percutaneous endoscopic gastrostomy feeds. Patients on nasogastric feeds developed 32 episodes of pneumonia over a total of 7884 days of feeds (1 every 246 days). Patients with percutaneous endoscopic gastrostomy feeds after a period of nasogastric feeds developed 48 pneumonia episodes over 36,238 days (1 every 755 days). Patients with percutaneous endoscopic gastrostomy feeds without previous nasogastric feeds developed 28 pneumonia episodes over 23,983 days (1 every 856 days), and this was statistically significant (χ^2 test p value <0.005). Forty-seven patients had died at the time of data collection, with 29 patients dying from pneumonia. One-week mortality was 3%, 30-day mortality was 8% and 1-year mortality was 39%. All patients dying within the first week and 50% of those dying within 30 days of the procedure died following pneumonia.* ***Conclusions:*** *There was a statistically significant decrease in the number of pneumonia episodes among patients receiving percutaneous endoscopic gastrostomy feeds versus nasogastric feeds. However, pneumonia is still the major cause of death among percutaneous endoscopic gastrostomy patients.*

Key words: Gastrostomy, percutaneous endoscopic gastrostomy, pneumonia, nasogastric

Perkütan endoskopik gastrostomi yerleştirilmesinden sonra görülen pnömoni ve mortalite

Amaç: *Perkütan endoskopik gastrostomi nörolojik disfajisi olan hastalarda enteral beslenme imkanı sunmaktadır. Otuz günlük mortalite oranları %4-26 arasında değişmektedir ve perkütan endoskopik gastrostomi yerleştirilmesinden sonra pnömoni sıktır.* ***Gereç ve Yöntem:*** *Bu çalışma Malta'da gerçekleştirilen (Ocak 2008-Haziran 2010) perkütan endoskopik gastrostomi işlemlerinin retrospektif analizini içermektedir ve hastaların nazogastrik tüp ile beslendikleri dönem ile perkütan endoskopik gastrostomi ile beslendikleri dönemdeki pnömoni sıklıkları karşılaştırılmıştır. Ayrıca perkütan endoskopik gastrostomi uygulamasının endikasyonları, kötü prognostik faktörleri ve mortalitesi incelenmiştir.* ***Bulgular:*** *Doksanyedi hastaya perkütan endoskopik gastrostomi uygulandı. Bunlardan 54'ü perkütan endoskopik gastrostomi öncesi dönemde nazogastrik tüp ile beslenmişdi. Nazogastrik tüp ile beslenen hastalarda toplam 7884 günde 32 pnömoni vakası (1 pnömoni/246 gün) tespit edildi. Nazogastrik tüp ile beslenme ertesinde perkütan endoskopik gastrostomi açılan hastalarda 36238 günde 48 pnömoni geliştiği (1 pnömoni/755 gün) tespit edildi. Nazogastrik tüp ile beslenme dönemi olmaksızın perkütan endoskopik gastrostomi açılan hastalarda 23983 günde 28 pnömoni (1 pnömoni/856 gün) tespit edildi (Chi-kare; p<0.005). Veri toplanması sırasında 47 hasta vefat etmişti ve bunlarda 29'u pnömoniye bağlıydı. Haftalık mortalite %3, aylık mortalite %8 ve 1 yıllık mortalite %39 olarak tespit edildi. İşlemden sonraki 1 hafta içinde ölümlerin tamamı ve 1 ay içindeki ölümlerin %50'si pnömoniye bağlı gelişti.* ***Sonuç:*** *Nazogastrik tüp ile beslenme ile karşılaştırıldığında perkütan endoskopik gastrostomi açılan hastalarda pnömoni sıklığında anlamlı bir azalma kaydedilmektedir. Her şeye rağmen perkütan endoskopik gastrostomi açılan hastalarda pnömoni en önemli ölüm nedenidir.*

Anahtar kelimeler: Gastrostomi, perkütan endoskopik gastrostomi, pnömoni, nazogastrik

Address for correspondence: Neville AZZOPARDI
Mater dei Hospital, Department of Gastroenterology,
Tal Qroqq, Malta
Phone: +356 998 53 695
E-mail: oldcharm@onvol.net

Manuscript received: 17.01.2012 **Accepted:** 27.03.2012

Turk J Gastroenterol 2013; 24 (2): 109-116
doi: 10.4318/tjg.2013.0512

INTRODUCTION

The introduction of percutaneous endoscopic gastrostomy (PEG) feeding in 1980 has resulted in an ever-increasing demand for endoscopic procedures to provide enteral feeding to patients who have lost enteral access but who retain the absorptive capacity of their gastrointestinal tract (1). There is considerable evidence of the benefits for maintaining nutrition in such patients. While nasogastric tubes (NGTs) are the established means of enteral access in acute cases, these tubes are often poorly tolerated in conscious patients and can lead to increased risk of nasal ulceration and aspiration pneumonias in the unconscious patient. PEG tube feeding is frequently regarded as a safe and effective method of providing long-term enteral nutrition to patients with neurological dysphagia and offers important advantages over NGT feeding, mainly because of greater weight gain and less treatment failure due to tube dislodgement (2). Studies have also shown that early gastrostomy tube feeding (at 14 days after the event) is greatly superior to NGT feeding and should be the nutritional treatment of choice for patients with acute dysphagic stroke (3). However, there is insufficient evidence to suggest that enteral tube feeding is beneficial in patients with advanced dementia, and most authors suggest a greater mortality and advise avoiding PEG insertion in these patients (4-7).

The recent guidelines on the provision of a PEG service were published in view of the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) report, which expressed concern over the morbidity and mortality associated with PEG placement. These guidelines highlighted the importance of adequate selection of patients for long-term enteral nutrition (8,9). The NCEPOD report revealed a 1-week mortality of 43% after PEG insertion, and in 19% of cases, the procedure was deemed futile by the same panel (10).

Ethical considerations should always be taken into account when selecting patients for PEG insertion, particularly with respect to their quality of life (11). Families and caregivers are frequently told about the plan to insert a PEG tube before it has been properly discussed. This can create unrealistic expectations, which make subsequent discussions with the family more difficult (8). Patients receiving a PEG are usually seriously ill, often with major neurologic disabilities. The extent of anticipated recovery may be limited or uncertain, and in some cases, a prolonged clinical course with deterioration to death occurs. Patients provided with long-term nutritional support via PEG may accordingly experience an extended life of poor quality and the burden of care frequently falls on the family (12). Studies have shown that in a substantial proportion of cases, the clinical course subsequent to PEG is poor. Patients interviewed after the procedure were uncertain that proceeding to nutritional support via a PEG had been the right decision (13).

Patients undergoing PEG are often at high risk for complications caused by associated comorbidity. Minor complications associated with PEG placement occur in 13-43% of patients (14-16), and include tube occlusion, maceration from leakage of gastric contents around the tube and peristomal pain. Major complications, reported in 0.4-8.4% of procedures (14,16-19), include wound infections, necrotizing fasciitis, aspiration, bleeding, perforation, ileus, injury of internal organs, tumor seeding, and death. Procedure-related mortality has been reported to range from 0-2% with a 30-day mortality in the range of 6.7-26% (14,16,20,21). This may be due, in part, to the patients' underlying comorbidities. Pneumoperitoneum occurs commonly after PEG and is of no clinical significance unless accompanied by signs and symptoms of peritonitis (22). The most common complication is wound infection. Antimicrobial prophylaxis is recommended because it may reduce the frequency of peristomal wound infection (23-27) and is cost-effective (28). A mature fistulous tract is required to safely replace a percutaneous gastrostomy tube/button. Non-endoscopic replacement of a dislodged tube/button is contraindicated in the absence of a mature tract. Non-operative management of early dislodgement of PEG tubes has been described (29).

MATERIALS AND METHODS

This is a retrospective study in which we analyzed all PEG insertions in our hospital performed between January 2008 and June 2010. Our hospital has a captive population of 400,000. Our aims were to analyze:

1. The indications for PEG insertion;
2. Mortality at 7 days, 30 days and 1 year post-PEG insertion and the poor prognostic factors (PPFs) for PEG insertion;
3. The incidence of pneumonia episodes among patients fed through a NGT versus among patients after insertion of a PEG tube.

Patients were referred for PEG insertion following consultation with a Speech and Language Pathologist (SLP) by their treating physician, and all patients were reviewed by the gastroenterology team prior to the PEG insertion. Post-PEG instructions and follow-up are usually carried out by a nutrition specialist nurse together with the treating gastroenterologist.

Patients were identified through the endoscopy unit database. The approval of the Data Protection Officer at our hospital was obtained. Data were collected through the patients' case notes and included the following:

- Patient characteristics (age, gender)
- Indication for PEG referral
- Duration of NG feeds prior to PEG insertion
- Number of pneumonia episodes while on NGT
- Duration of PEG feeds
- Number of pneumonia episodes while on PEG tube
- Mortality figures at 7 days, 30 days and 1 year
- Cause of death
- Poor prognostic factors (PPFs) for PEG insertion – the PPFs that were analyzed included:
  a. Male gender
  b. Age >65 years
  c. Dementia
  d. Albumin level <30 g/L
  e. Recurrent aspiration pneumonia
  f. Heart failure
  g. History of subtotal gastrectomy
  h. Presence of bedsores
  i. Presence of advanced malignancy
- Patient nil by mouth (or nil by NGT) for ≥11 days
- Need and indication for PEG re-insertion
- Albumin level within 28 days prior to PEG insertion
- Use of prophylactic antibiotics
- Use of sedation or general anesthesia

Statistical Analysis

A Pearson chi-square test was performed to analyze the ratio of the number of days with pneumonia against the duration of feeds through NGTs and PEG tubes. A Pearson chi-squared test was also used to analyze the association between different PPFs and 30-day mortality.

RESULTS

Patient Characteristics

Ninety-seven patients (44 male, 53 female) underwent PEG insertion in the 30-month period under study. As shown in Figure 1, PEGs were inserted at different ages, though they were more common with increasing age. All patients received prophylactic antibiotics as per guidelines (30). Intravenous midazolam was the drug used for sedation in 85.3% of patients. In 12.4% of cases, the procedure was performed using propofol, while in 2 procedures (2.1%) only local anesthesia was used.

Indication for Referral

The indications for PEG insertion are demonstrated in Figure 2. The main indication was neurologically unsafe swallowing. This broad category can be divided into (a) neurologically unsafe swallowing following a cerebrovascular accident and (b) neurologically unsafe swallowing secondary to progressive neuromuscular degeneration (56% - including Huntington's disease, Parkinson's disease, progressive dementia, motor neurone disease, cerebral palsy, and other progressive disorders including hydrocephalus, Down's syndrome, progressive supranuclear palsy, familial neurodegenerative disorder, and spinocerebellar degeneration). Other reasons for referral were malignancy (nasopharyngeal, oropharyngeal, gastrointestinal and cerebellar) and persistent vegetative states.

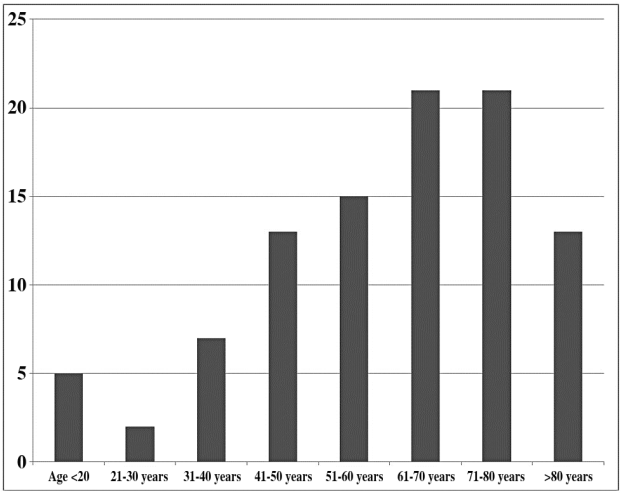

Figure 1. Numbers of PEGs inserted according to age.

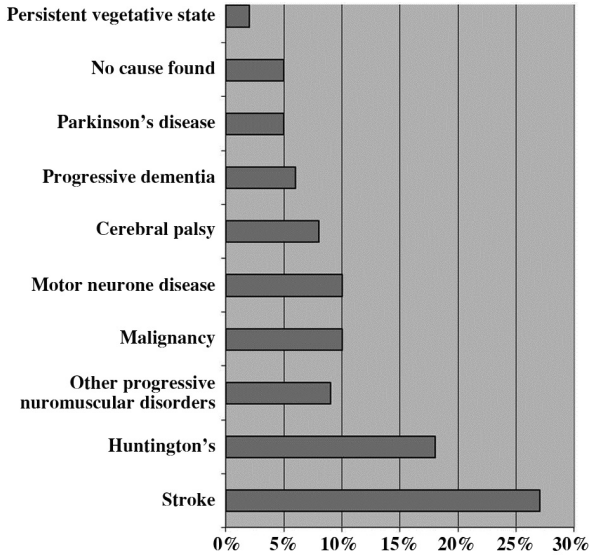

Figure 2. Indications for PEG insertion.

Pneumonias in NGT- and PEG Tube-Fed Patients

Only 54 of the patients in the study had a NGT inserted before the PEG insertion. 29.6% of patients with a NGT developed at least one pneumonia episode while receiving NG feeds. The mean in-hospital stay for admissions with pneumonia was 8.5 days. The mean duration of NG feeds in the patients with a cerebrovascular accident was 85.3 days (range, 7–348 days). Patients were divided into three subgroups as follows:

- Patients developing pneumonia while on NG feeds;
- Patients developing pneumonia while on PEG feeds following NG feeds;
- Patients developing pneumonia while on PEG feeds without having previous NG feeds.

Table 1 demonstrates the results in these patients. 34.0% of patients with a PEG tube developed at least one pneumonia episode. The total in-patient hospital stay for pneumonia during PEG feeds was 646 days, or 8.5 days for each pneumonia episode. Statistical analysis using chi-squared test comparing the ratio of the in-hospital man-days with pneumonia with the total number of days on NG/PEG feeds was significant for the three subgroups (χ^2 value = 279.686, $p<0.005$). Thus, during the same time period, patients with a NGT developed pneumonia three times more frequently than those fed by PEG tube.

Figure 3 describes the frequency of pneumonia in patients requiring enteral feeding for different pathologies. Eight patients experienced recurrent pneumonia while receiving nutrition first through a NGT and subsequently through a PEG tube. Eight patients developed pneumonia only while receiving NG feeds with no further pneumonia upon PEG insertion. Twenty-five patients had pneumonia only when fed through a PEG tube, either because no NGT was inserted before the PEG tube or because the patient had no pneumonia episode while receiving NG feeds.

Mortality

The cause of death in these patients is displayed in Figure 4, while Table 2 describes the 7-day, 30-

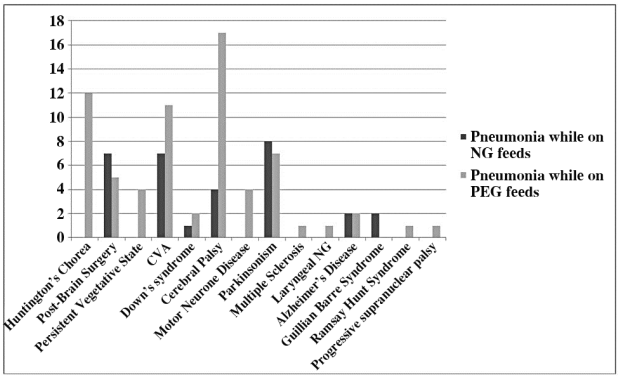

Figure 3. Frequency of pneumonia in patients requiring enteral feeding for different pathologies.

Table 1. Pneumonias in patients with NG/PEG feeds

	NG feeds	PEG feeds following NG feeds	PEG feeds in patients without previous NG feeds
Number of patients developing pneumonia	16	22	12
Number of pneumonia episodes	32	48	28
Total number of patients	54	54	43
Days on NG / PEG feeds	7884	36,238	23,983
In-hospital man-days with pneumonia	262 days	455 days	191 days
Frequency of pneumonia	1 every 246 days	1 every 755 days	1 every 856 days

NG: Nasogastric. PEG: Percutaneous endoscopic gastrostomy.

Table 2. Early mortality figures

Time post-PEG insertion	Number of deceased patients	Percentage of total number of patients
7-day mortality	3	3.1%
30-day mortality	8	8.24%
1-year mortality	38	39.17%

PEG: Percutaneous endoscopic gastrostomy.

Table 3. Indication for PEG insertion in patients with 30-day mortality

Indication for PEG	Number of patients with 30-day mortality	Percentage
Huntington's disease	3	37.5%
Gastrointestinal malignancy	1	12.5%
Laryngeal/tongue malignancy	1	12.5%
Motor neurone disease	1	12.5%
Down's syndrome	1	12.5%
Massive stroke	1	12.5%

PEG: Percutaneous endoscopic gastrostomy.

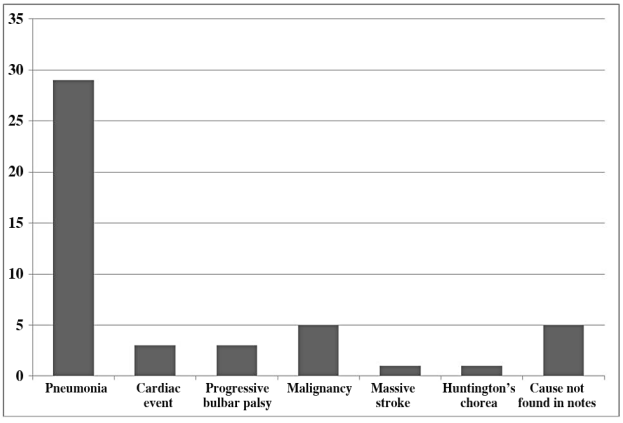

Figure 4. Cause of death following PEG insertion.

day and 1-year mortality figures. Three patients died within one week of the procedure. One patient died secondary to a colonic perforation complicated by pneumonia. The other two patients died secondary to pneumonia. A PEG was deemed necessary in these patients because of swallowing impairment secondary to Huntington's disease, laryngeal malignancy and Down's syndrome.

The indications for referral for PEG insertion in patients who died within 30 days after the procedure are described in Table 3. Pneumonia was the cause of death in 50% of patients dying within 30 days of the procedure.

Poor Predictive Factors Before PEG Insertion

The incidence of PPF in those patients who died within the 30-day mortality figure was analyzed. All patients who were within this category had at least 1 PPF. Two patients had 1 PPF, 1 patient had 2 PPFs and 5 patients had 3 PPFs. The commonest PPFs were male gender (62.5%), history of recurrent aspiration pneumonia (50%), age >65 years (37.5%), dementia (37.5%), and advanced malignancy (25%). Each PPF was statistically analyzed for an association with 30-day mortality using the Pearson chi-squared test. However, there was no dependence or association found in these variables (male sex p=0.0788, aspiration pneumonia p=0.8308, age >65 years p=0.5574, dementia p=0.5574, hypoalbuminemia p=0.7430, and advanced malignancy p=0.2034).

Thirty-one patients (31.95%) had their albumin level checked within 28 days before the PEG insertion, and their mean albumin level was 34.47 g/dl (range, 22.0–47.9 g/dl). Seventeen patients (54.8% of those having their albumin level checked) had a serum albumin level <34.0 g/dl, while 8 patients (25.8% of those having the test) had an albumin level <30 g/dl. Three of the patients with severe hypoalbuminemia had suffered a major cerebrovascular event. The relationship of the number of PPFs and PEG insertion is demonstrated in Figure 5, while the incidence of the different PPFs is demonstrated in Figure 6.

Need for PEG Reinsertion

Twenty-three patients (23.7%) required reinsertion of the gastrostomy tube. The reasons for reinsertion of the PEG tube included 32 cases of a dislodged PEG tube, 5 cases of a fractured PEG tube and 1 case of a leaking tube.

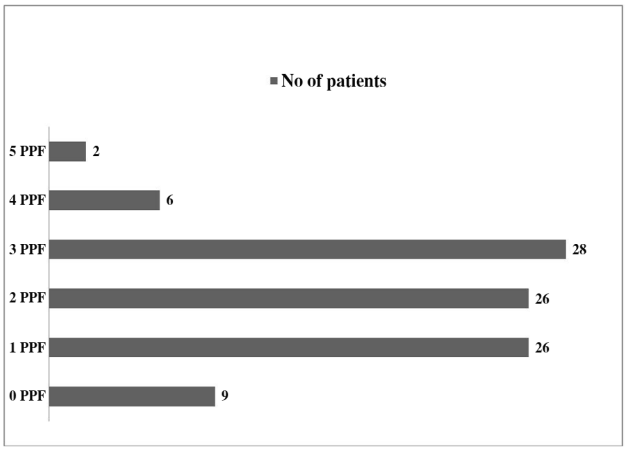

Figure 5. Number of poor predictive factors in patients before PEG insertion.

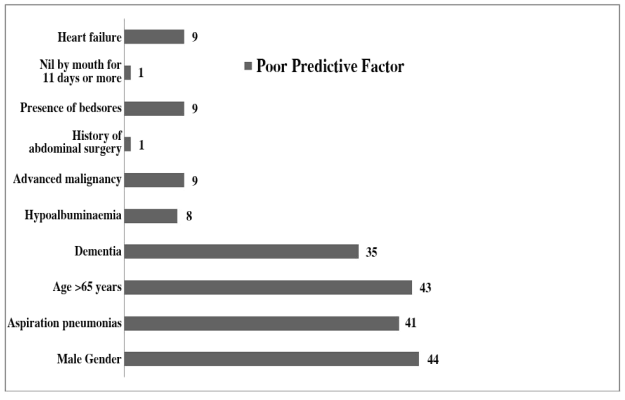

Figure 6. Types of poor predictive factors before PEG insertion.

DISCUSSION

The results from this study indicate that up to 83% of all PEG tubes inserted are performed due to neurologically unsafe swallowing (27% following a cerebrovascular accident and 56% for a progressive neuromuscular condition that impairs swallowing). Only 6% of referrals were due to dementia, reflecting appropriate patient selection before the procedure. Our study clearly demonstrates that patients with NGT are three times more likely to develop pneumonia than patients with a PEG (p value <0.005). This reduced risk is equally statistically significant between patients with a PEG who did or did not have a NGT prior to PEG insertion. This further demonstrates the conferred advantage of PEG insertion. Furthermore, due to this advantage, the amount of hospital admissions for patients with PEGs was lower than for patients with NGT.

Advanced age and cerebrovascular accident are associated with a higher risk of pneumonia (31). In our study, cerebral palsy was associated with a higher risk of pneumonia (p value = 0.033). A prospective study (31) on 24 patients undergoing a PEG insertion revealed an increased incidence of pneumonia in patients with esophagitis during the insertion and in those with a prior history of pneumonia. None of our pneumonia patients had documented esophagitis during the PEG insertion, while 24.2% of our patients had a prior history of pneumonia while on NG feeds. Those patients who developed pneumonia while on PEG feeds had an average age at insertion of 60.4 years (range, 16–82 years). Patients who developed pneumonia while on NG feeds had an average age at insertion of 57.2 years (range, 16–89 years).

There was a significant delay in PEG insertion in our stroke patients, with a mean duration between NG and PEG insertion of 85.3 days. This contrasts with the recommendations in the guidelines to insert a gastrostomy tube 14 days after the cerebrovascular event (8). These data might explain in part the higher incidence of pneumonia among NGT-fed patients.

Does this mean, therefore, that PEG tubes will be uniformly effective in preventing pneumonia? As the mortality figures show, pneumonia is still the major cause of death among patients with a PEG tube, with a significant 62% all-cause mortality, 50% 30-day mortality and 100% 1-week mortality. Interestingly, 50% of the patients who developed pneumonia while receiving NG feeds also developed pneumonia while receiving PEG feeds. The indications for PEG insertion in these patients were swallowing impairment secondary to Parkinson's disease (37.5%), cerebrovascular accident (37.5%), cerebral palsy (12.5%), and Down's syndrome (12.5%). These data might indicate that patients suffering from certain conditions might be more prone to aspirate, whichever method is used. This was not statistically significant in view of the small numbers in the study (only 8 patients developed pneumonia while receiving NG feeds and also while receiving PEG feeds). Figure 3 above demonstrated how pneumonia in conditions like Huntington's disease and cerebral palsy remains very common notwithstanding PEG insertion. Another possibility is that the feeds are being given to patients in the prone position, which may predispose to reflux and aspiration of gastric contents.

These data highlight the importance of adequate education of caregivers and post-PEG insertion

follow-up. This service should be provided by a multidisciplinary Nutrition Care Team including nutrition nurses, speech pathologists, gastroenterologists, patients, and caregivers. This team should also be involved in the decision-making process as to whether a percutaneous feeding tube is in the patient's best interest (32). Evidence suggests that complications related to tube feeding are less common in hospitals with a functioning multidisciplinary team (33). A well-functioning nutrition team can also reduce the number of inappropriate PEG tube insertions (34-36).

Thirty-day mortality rates varying between 4.1% and 26% have been described in different studies (37). In a cohort of 7369 veterans who underwent PEG, 23.5% died during the hospital admission during which the PEG was placed, and the median survival was only 7.5 months (38). In another study of 81,105 older Medicare beneficiaries who underwent gastrostomy placement (59,969 PEG and 21,136 operatively placed), in-hospital mortality occurred in 15.3%. The 1- and 3-year mortality rates were 63.0% and 81.3%, respectively (39). The 8% 30-day mortality and 39% 1-year mortality figures in our study are significant in that they stress the importance of careful patient selection before the procedure. While these figures might improve to a certain extent with more stringent selection criteria, ethical issues frequently arise that may complicate these decisions. The prognostic factors mentioned above might help in the final decision as to which patients should undergo PEG insertion. Though no statistically significant association could be found in this study, PPFs might still have a role in deciding which patients should undergo PEG insertion. As demonstrated in the results, all patients who died within 30 days had at least one PPF, with 62.5% having three PPFs. The lack of a statistically significant association between the PPF and 30-day mortality might be explained by the limited numbers analyzed in this study.

Patients with poor nutrition are likely to do worse after PEG insertion, with an increased early mortality (40). Hypoalbuminemia is frequently a marker of poor nutrition. A limitation of our study with regards to PPF was that only 32% had a serum albumin available prior to PEG insertion. Studies have recommended that there may be some benefit in performing PEG before the onset of severe hypoalbuminemia (40). While low albumin is a PPF for PEG insertion, further studies are required to investigate whether correction of hypoalbuminemia before the procedure decreases post-PEG mortality. A low serum albumin before the procedure may help predict mortality following PEG insertion and thus may be important in appropriate patient selection before the procedure.

In conclusion, PEG insertion in patients with neurological dysphagia decreases the frequency of pneumonia when compared to NG feeding. However, pneumonia is still the major cause of death among these patients. This should be adequately explained to patients and their caregivers before they consent to the procedure. Careful patient selection for PEG insertion, taking into consideration any PPF, may help further improve the mortality associated with this procedure.

REFERENCES

1. Kurien M, McAlindon ME, Westaby D, Sanders DS. Percutaneous endoscopic gastrostomy (PEG) feeding. BMJ 2010; 340: c2414.
2. Park R, Allison MC, Lang J, et al. Randomised comparison of percutaneous endoscopic gastrostomy and nasogastric feeding in patients with persistent neurological dysphagia. BMJ 1992; 304: 1406-9.
3. Norton B, Homer-Ward M, Donnelly MT, et al. A randomised prospective comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding after acute dysphagic stroke. BMJ 1996; 312: 13.
4. Candy B, Sampson EL, Jones L. Enteral tube feeding in older people with advanced dementia: findings from a Cochrane systematic review. Int J Palliat Nurs 2009; 15: 396-404.
5. Murphy LM, Lipman TO. Percutaneous endoscopic gastrostomy does not prolong survival in patients with dementia. Arch Intern Med 2003; 163: 1351e3.
6. Rimon E, Kagansky N, Levy S. Percutaneous endoscopic gastrostomy; evidence of different prognosis in various patient subgroups. Age Ageing 2005; 34: 353e7.
7. Sanders DS, Carter MJ, D'Silva J, et al. Survival analysis in percutaneous endoscopic gastrostomy feeding: a worse outcome in patients with dementia. Am J Gastroenterol 2000; 95: 1472e5.
8. Westaby D, Young A, O'Toole P, et al. The provision of a percutaneously placed enteral tube service. Gut 2010; 59: 1592-605.
9. NCEPOD. National confidential enquiry into patient outcome and death: scoping out practice. London: National Confidential Enquiry into Patient Outcome and Death, 2004.
10. Johnston SD, Tham TC, Mason M. Death after PEG: results of the National Confidential Enquiry into Patient Outcome and Death. Gastrointest Endosc 2008; 68: 223-7.

11. Rabeneck L, McCullough LB, Wray NP. Ethically justified, clinically comprehensive guidelines for percutaneous endoscopic gastrostomy tube placement. Lancet 1997; 349: 496-8.
12. Verhoef MJ, Van Rosendaal G. Patient outcomes related to percutaneous endoscopic gastrostomy placement. J Clin Gastroenterol 2001; 32: 49-53.
13. Van Rosendaal G, Verhoef MJ, Mace SR, Kinsella TD. Decision-making and outcomes for percutaneous endoscopic gastrostomy: a pilot study. J Clin Gastroenterol 1997; 24: 71-3.
14. Larson DE, Burton DD, Schroeder KW, DiMagno EP. Percutaneous endoscopic gastrostomy. Indications, success, complications, and mortality in 314 consecutive patients. Gastroenterology 1987; 93: 48-52.
15. Akkersdijk WL, van Bergeijk JD, van Egmond T, et al. Percutaneous endoscopic gastrostomy (PEG): comparison of push and pull methods and evaluation of antibiotic prophylaxis. Endoscopy 1995; 27: 313-6.
16. Mathus-Vliegen LM, Koning H. Percutaneous endoscopic gastrostomy and gastrojejunostomy: a critical reappraisal of patient selection, tube function and the feasibility of nutritional support during extended follow-up. Gastrointest Endosc 1999; 50: 746-54.
17. Foutch PG, Haynes WC, Bellapravalu S, Sanowski RA. Percutaneous endoscopic gastrostomy (PEG). A new procedure comes of age. J Clin Gastroenterol 1986; 8: 10-5.
18. Amann W, Mischinger HJ, Berger A, et al. Percutaneous endoscopic gastrostomy (PEG). 8 years of clinical experience in 232 patients. Surg Endosc 1997; 11: 741-4.
19. Rabeneck L, Wray NP, Petersen NJ. Long-term outcomes of patients receiving percutaneous endoscopic gastrostomy tubes. J Gen Int Med 1996; 11: 287-93.
20. Wolfsen HC, Kozarek RA, Ball TJ, et al. Long-term survival in patients undergoing percutaneous endoscopic gastrostomy and jejunostomy. Am J Gastroenterol 1990; 85: 1120-2.
21. Hull MA, Rawlings J, Murray FE, et al. Audit of outcome of long-term enteral nutrition by percutaneous endoscopic gastrostomy. Lancet 1993; 341: 869-72.
22. Gottfried EB, Plumser AB, Clair MR. Pneumoperitoneum following percutaneous endoscopic gastrostomy. A prospective study. Gastrointest Endosc 1986; 32: 397-9.
23. Akkersdijk WL, van Bergeijk JD, van Egmond T, et al. Percutaneous endoscopic gastrostomy (PEG): comparison of push and pull methods and evaluation of antibiotic prophylaxis. Endoscopy 1995; 27: 313-6.
24. Jain NK, Larson DE, Schroeder KW, et al. Antibiotic prophylaxis for percutaneous endoscopic gastrostomy. A prospective, randomized, double blind clinical trial. Ann Int Med 1987; 107: 824-8.
25. Gossner L, Keymling J, Hahn EG, Ell C. Antibiotic prophylaxis in percutaneous endoscopic gastrostomy (PEG): a prospective randomized clinical trial. Endoscopy 1999; 31: 119-24.
26. Preclik G, Grune S, Leser HG, et al. Prospective, randomised, double blind trial of prophylaxis with single dose of coamoxiclav before percutaneous endoscopic gastrostomy. BMJ 1999; 319: 881-4.
27. Dormann AJ, Wigginghaus B, Risius H, et al. A single dose of ceftriaxone administered 30 minutes before percutaneous endoscopic gastrostomy significantly reduces local and systemic infective complications. Am J Gastroenterol 1999; 94: 3220-4.
28. Kulling D, Sonnenberg A, Fried M, Bauerfeind P. Cost analysis of antibiotic prophylaxis for PEG. Gastrointest Endosc 2000; 51: 152-6.
29. Pofahl WE, Ringold F. Management of early dislodgment of percutaneous endoscopic gastrostomy tubes. Surg Laparoscopy Endosc Percutaneous Tech 1999; 9: 253-6.
30. Allison MC, Sandoe JAT, Tighe R, et al. Antibiotic prophylaxis in gastrointestinal endoscopy. Gut 2009; 58: 876.
31. Patel PH, Thomas E. Risk factors for pneumonia after percutaneous endoscopic gastrostomy. J Clin Gastroenterol 1990; 12: 389-92.
32. Kasarskis E J, Scarlata D, Hill R, et al. A retrospective study of percutaneous endoscopic gastrostomy in ALS patients during the BDNF and CMTF trials. J Neurol Sci 1999; 169: 118e25.
33. Powers DA, Brown RO, Cowan GS Jr, et al. Nutritional support team vs nonteam management of enteral nutritional support in a Veterans Administration Medical Center teaching hospital. JPEN 1986; 10: 635e8.
34. Abuksis G, Mor M, Plaut S, et al. Outcome of percutaneous endoscopic gastrostomy (PEG): comparison of two policies in a 4-year experience. Clin Nutr 2004; 23: 341e6.
35. Sanders DS, Carter MJ, D'Silva J, et al. Percutaneous endoscopic gastrostomy: a prospective audit of the impact of guidelines in 2 district general hospitals in the United Kingdom. Am J Gastroenterol 2002; 97: 2239-45.
36. Monteleoni C, Clark E. Using rapid-cycle quality improvement methodology to reduce feeding tubes in patients with advanced dementia: before and after study. BMJ 2004; 329: 491-4.
37. Abuksis G, Mor M, Segal N, et al. Percutaneous endoscopic gastrostomy: high mortality rates in hospitalized patients. Am J Gastroenterol 2000; 95: 128-32.
38. Rabeneck L, Wray NP, Petersen NJ. Long-term outcomes of patients receiving percutaneous endoscopic gastrostomy tubes. J Gen Int Med 1996; 11: 287-93.
39. Grant MD, Rudberg MA, Brody JA. Gastrostomy placement and mortality among hospitalized Medicare beneficiaries. JAMA 1998; 279: 1973-6.
40. Nair S, Hertan H, Pitchumoni CS. Hypoalbuminaemia is a poor predictor of survival after percutaneous endoscopic gastrostomy in elderly patients with dementia. Am J Gastroenterol 2000; 95: 133e6.