

Nutritional support via percutaneous endoscopic gastrostomy

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Nutritional support is often an integral part of patient management. There are three principal access routes used for nutrient delivery: oral, enteral (tube feeding) and parenteral.

Tube feeding is indicated for those patients who, in the presence of a functional gastrointestinal tract, cannot, should not or will not consume adequate nutrition orally. A number of different routes may be used in administering enteral feeds, which include nasogastric (NG), nasojejunal and enterostomy (e.g. percutaneous endoscopic gastrostomy (PEG)) methods. PEG feeding is the main topic of the present review.

The concept of nutritional support via gastrostomy was first proposed by a Norwegian surgeon, Egeberg, in 1837 and first performed on the animal model by Sedillot in 1839. In 1876, Verneuil successfully performed a surgical gastrostomy in man. It was the advent of the flexible endoscope a century later that enabled the percutaneous endoscopic technique to be developed. This was first described and performed by Guaderer and Ponsky late in 1979 (Lo & Dornbrand, 1989).

NUTRITIONAL SUPPORT

When it is judged that a patient requires nutritional support, following a full nutritional assessment (Thomas, 1988), a decision must be made concerning how the required nutrients should be delivered. Where possible, use of the oral route is preferable (Jayson-Payne, 1992). In this case, energy and nutrient intake can be manipulated using energy- and nutrient-dense foods, frequently in association with nourishing drinks (usually commercially prepared) with or without supplements. Food and fluid texture may need to be altered, particularly in the dysphagic patient, to reduce the dangers of aspiration by enhancing safer swallowing.

If oral intake is inadequate or contraindicated and the gastrointestinal tract is functional, then enteral tube feeding is preferable to parenteral nutritional support, due to the higher complications and costs associated with the latter (Armstrong *et al.* 1990). The specific route chosen to deliver enteral feeds will depend on the following: (1) the presence of a self-limiting illness which may only require short-term feeding, (2) the presence of chronic pathology which may necessitate long-term or indefinite nutritional support (Jayson-Payne, 1992).

Until recently, NG feeding has been implemented for both short-term and long-term tube feeding. However, a number of problems are associated with the use of NG tubes over the longer term (for example, 4 weeks or more). These include nasal and oral discomfort (particularly with Ryles tubes), tube blockage and unplanned extubation by patient or staff. Should recurrent intubation be necessary, this increases the risks of

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Table 1. *Specific indications for percutaneous endoscopic gastrostomy (PEG) feeding*

1. Neurological disorders or trauma	4. Intensive care
Stroke	
Head injury	5. Tracheo-oesophageal fistulas
Hemiplegia	
Degenerative diseases of the CNS	6. Rare indications
Other neurological conditions	Short bowel syndrome
	Gastric decompression
2. Oropharyngeal disorders	Recurrent aspiration (on NG feeding)
Cancers of the head and neck	Inflammatory myopathy
	Connective tissue disease
3. Supplemental feeding	Macroglossia secondary to amyloid
Cystic fibrosis	Severe burns
AIDS	

CNS, central nervous system; AIDS, acquired immune deficiency syndrome; NG, nasogastric.

oesophageal perforation and malpositioning complications (Jackson *et al.* 1990). In addition, many patients or their families object to the physical presence of a nasoenteric tube.

When the patient is expected to need enteral nutritional support for a long period, PEG has clear advantages over the nasoenteric routes (Larson *et al.* 1987; Johnston *et al.* 1993). PEG tubes are rarely removed inadvertently, therefore the patient is more likely to receive the prescribed quantity of nutrients and, thus, achieve the desired objectives of weight gain and improved nutritional status (Forgacs *et al.* 1992; Park *et al.* 1992). Once the stoma has healed, PEG tubes cause little or no physical discomfort. In addition, a PEG tube can remain *in situ* for up to 3 years, a more desirable alternative than recurrent nasogastric intubation. A decreased risk of aspiration has been reported (Ciocon *et al.* 1990), although this is not universally agreed (Jarnagin *et al.* 1992). As the PEG tube is concealed by clothing when not in use, it is less obtrusive than the nasoenteric alternatives.

As a rule, PEG is preferred to surgical gastrostomy because it is a minimally invasive surgical procedure, is more cost effective and has fewer associated complications (Moran *et al.* 1990; Sali *et al.* 1993).

INDICATIONS FOR PERCUTANEOUS ENDOSCOPIC GASTROSTOMY FEEDING

PEG feeding can be used in a wide variety of disease states (see Table 1), but these can be categorized broadly into: (1) patients having reversible disease with potential for recovery, (2) patients suffering from incurable diseases with potentially extended survival, (3) patients who are terminally ill or seriously debilitated (Wolfson *et al.* 1990a).

PEG feeding is most frequently used for patients who cannot eat enough to meet their needs, primarily those with neurological disorders and associated dysphagia (Allison *et al.* 1992), such as stroke (Roukema *et al.* 1990; Sali *et al.* 1993), head injury or trauma (Larson *et al.* 1987), degenerative diseases of the central nervous system (Raha *et al.* 1991) and cancer of the head and neck (Fietkau *et al.* 1989). PEG is also effective for supplemental feeding in conditions such as cystic fibrosis (Steinkamp *et al.* 1990) and acquired immune deficiency syndrome (AIDS; Kotler *et al.* 1991).

Table 2. *Specific contraindications to percutaneous endoscopic gastrostomy (PEG) feeding*

1. Contraindications to endoscopy
Severe tumours of the head and neck
2. Contraindications to gastrostomy
Massive obesity
Massive ascites
Peritoneal dialysis
Peritonitis
Acute pancreatitis
Portal hypertension
Coagulation disorders
3. Contraindications to gastric instillation of feeds
Severe gastro-oesophageal reflux
Gastric outlet obstruction

CONTRAINDICATIONS TO PERCUTANEOUS ENDOSCOPIC GASTROSTOMY FEEDING

PEG feeding is unsuitable for cases where: (1) oral intake is sufficient or where nutritional support is only required for short periods (for example less than 4 weeks), (2) enteral feeding is contraindicated, (3) the patient or the next-of-kin (when the patient is unable to communicate) objects (Lo & Dornbrand, 1989), (4) the patient is terminally ill (Wolfson *et al.* 1990b), (5) endoscopy is impractical or contraindicated (O'Dwyer *et al.* 1990).

PLANNING THE PERCUTANEOUS ENDOSCOPIC GASTROSTOMY NUTRITIONAL SUPPORT REGIMEN

The process of planning the enteral nutritional support regimen is the same, regardless of the access route chosen. Individual energy, protein, nutrient and fluid requirements are assessed using standard formulas (Thomas, 1988). Based on the calculated requirements, the appropriate feeding formula is selected. This is generally a 4.2 kJ/ml polymeric feed, frequently administered in volumes of 2.0–2.5 l/d, with a fibre content varying from 0–15 g/l. Commercial formulas are available to cater for a wide range of energy, protein and electrolyte requirements.

Partially or fully predigested protein feeds, may be used if the access route is to the lower duodenum or jejunum, or if there is a malabsorptive syndrome. The method by which the feeding formula is delivered varies from one hospital to another. Many choose continuous feeding with pump assistance (although a pump is not essential). Feeding is commenced at reduced rates and increased over 2–3 d to allow delivery of the daily target volume (the rate of increase varies between patients according to individual tolerance). Peripheral fluids are simultaneously administered at reduced rates and discontinued when the target enteral feed volume is achieved. Alternatively, some choose to vary the concentration of feed rather than the rate of its delivery, beginning the regimen with

diluted feeds and increasing their concentration over several days. This approach has financial and practical benefits, as it reduces or eliminates the necessity for concurrent administration of peripheral fluids. Although referred to as continuous feeding, a common practice is to administer the enteral nutrition solution in several feeding periods. Each feed may last 6–8 h, such that the duration of feeding may last between 16 and 24 h/d. This type of feeding protocol allows tight control of the amount and rate of feed delivered, whilst requiring less nursing time than bolus feeding. It is also particularly suitable for patients with a tendency to gastro-oesophageal reflux.

Bolus feeding is often preferred by patients and staff because it mimics the normal eating pattern more closely and it allows independence from pumps. Many alert and mobile patients feel that it is user-friendly and suits their lifestyle. However, where unconscious or immobile patients are concerned, bolus feeding is labour-intensive for the carers. It is important that the feeding method chosen (continuous or bolus) should suit the hospital or home routine and that the patient's preference be considered.

Feeding is often commenced 12 h after insertion of the PEG tube, although some centres delay this for up to 24 h, preferring to flush the tube with either saline or dextrose solution at regular intervals (for example, at intervals of 6 h).

MONITORING

Careful clinical, anthropometric, haematological and biochemical monitoring of the patient receiving enteral nutritional support is important in evaluating the efficacy of a feeding regimen and the patient response to therapy. Clinical assessment should include measurement of vital signs and checking for signs of gastrointestinal intolerance (nausea, vomiting, diarrhoea, bloating and abdominal distension). Until the patient's condition has stabilized, fluid balance and bowel activity should be assessed daily. The position of the tip of the PEG tube should be checked occasionally by aspirating lumen fluid and checking for gastric acid. The patient's level of satisfaction with the nutritional therapy should also be monitored.

Anthropometric variables, including body weight, should be measured periodically. Where practicable, this should be carried out at weekly intervals initially, then monthly for patients in hospital and every 3–6 months for those in the community.

Haematological and biochemical monitoring, which should be performed at similar intervals, usually consists of a full blood count and measurement of serum electrolytes, glucose, urea, albumin and transferrin. It may be necessary to measure trace elements, folate and vitamin B₁₂ monthly in patients who are at higher risk of micronutrient deficiency (such as the elderly or those with chronic malabsorptive conditions).

COMPLICATIONS AND PREVENTION OF PROBLEMS DURING PERCUTANEOUS ENDOSCOPIC GASTROSTOMY FEEDING

Major complications (see Table 3) with the use of PEG feeding are uncommon; incidence rates of 1–3% over variable periods of time (Gay *et al.* 1992) and 30 d mortality rates in the region of 1% (Hollands *et al.* 1989) have been reported. However, the rate of minor complications (such as reflux aspiration, gastrostomy wound infection, tube blockage or rupture) is more significant (Seyrig *et al.* 1990), with some authors reporting

Table 3. *Complications of percutaneous endoscopic gastrostomy (PEG) feeding*

1. Major	2. Minor	3. Late
Aspiration pneumonia	Pyrexia	Catheter displacement or rupture
Gastric perforation	Wound infection	Local peritonitis
Gastric bleeding	Abscess of the abdominal wall	Respiratory problems
Haematoma	Stomal leaks	Tube impaction
	Tube migration	
	Auto-extubation	
	Aspiration of feeds	
	Anorexia	

rates as high as 13% (Hull *et al.* 1993). Complication rates are likely to be higher if PEG feeding is used in unsuitable patients and, therefore, can be expected to decline as PEG usage becomes more established.

Education of both carers and patients is essential for the successful application of PEG feeding and to reduce unnecessary complications. Carers should be educated about all aspects of PEG before they assume the care of patients on PEG feeding. Patients should be educated about PEG tubes, their care and the feeding regimen before tube insertion. At present, it is unfortunate that appropriate and well-timed education is not always provided.

GASTROSTOMY-RELATED PROBLEMS

The short-term incidence of wound infection is frequently as high as 6% (Hull *et al.* 1993). Prophylactic administration of a single intravenous dose of a broad-spectrum antibiotic before tube insertion can help to prevent wound infection. Following the insertion of a PEG tube, the stoma is covered with an antiseptic dressing until it heals (usually no more than 10–12 d). Once healing is complete, the stoma should not be considered a wound and need not necessarily be dressed, although some leakage of gastric fluid around the tube may be experienced. Consequently, the site should be checked daily for rash, irritation and tenderness. The peristomal region should be washed daily with soap and water and dried thoroughly. The tube should be routinely partially rotated *in situ* to assess whether or not there is deep tenderness and to minimize the likelihood of epithelialization of the internal flange (Lipscomb *et al.* 1994).

Blockage of the tube has been reported to occur in 2–18% of patients on PEG feeding. This can occur as an early or a late complication (Hull *et al.* 1993). Blockages are more likely to occur if staff have insufficient training or experience in using PEG tubes, or if the patient has not been adequately educated about care of their tube. Blocked tubes are more likely to rupture, to need replacement and to be a source of infection (Gottlieb *et al.* 1993). Tube blockage can be prevented by applying simple measures such as limiting the use of the tube to fluids (feeding formulas, water, liquid medications) and flushing the tube before and after each feed. Should the tube become blocked, it may be cleared by gently administering approximately 50 ml water, a carbonated beverage (e.g. 7-Up), diluted vinegar, diluted lemon juice, or bicarbonate of soda using a 20 ml or 50 ml syringe.

Tubes with significant extra-corporeal length should be taped securely to the abdominal skin surface (to avoid accidental dislodgement). When the tube is not in use it should be closed (using the clamp or stopper provided in the PEG kit).

GASTROINTESTINAL PROBLEMS

Many patients suffer from a dry mouth (xerostomia) and poor oral hygiene during PEG feeding because their oral intake is minimal or non-existent. The xerostomia may be worsened by concomitant use of drugs which decrease salivation (e.g. sedatives) and by the hospital environment, which tends to be warm and dry. This oral dryness and accompanying halitosis can cause considerable discomfort to the patient. There are now a number of commercially-available artificial salivas (presented as sprays) which can be very helpful in the treatment of these symptoms. The artificial salivas moisten the mouth but do not stimulate salivation and, therefore, are suitable for dysphagic patients (in whom excessive saliva may be inhaled). Inhalation of saliva or feeds into the lungs may result in aspiration pneumonitis or pneumonia. Gastro-oesophageal reflux and pulmonary aspiration of feeds is one of the more frequent complications of NG or PEG feeding. Patients who have a known history of aspiration or gastro-oesophageal reflux, or who have an increased risk of oesophageal reflux (elderly, immobile or bedridden patients), or who are noted to have oesophagitis during PEG placement, are more likely to suffer from aspiration (Patel & Thomas, 1990). Preventative measures, which may reduce the incidence of aspiration but will not eliminate it, include elevation of the bed-head to 30° from the horizontal and positioning the patient in an upright position during feeding (particularly if bolus feeding). If gastric emptying is delayed, the rate of continuous feeding or the timing of bolus feeds may need to be adjusted. Delaying feeding (by 1–3 h) has been recommended if the gastric residue is found to be more than 100 ml (Metheny *et al.* 1993). Alternatively, a prokinetic motility agent may be used. If a patient is prone to aspiration, it may be preferable to use a longer tube through the percutaneous gastrostomy, allowing placement of the tube tip into the jejunum (DiSario *et al.* 1990). In some cases, it may be necessary to consider using a concurrent tracheostomy (e.g. in unconscious patients; Wolfson *et al.* 1990b).

A significant number of enterally-fed patients experience diarrhoea. The enteral feed is often not the cause. If the diarrhoea is associated with the initiation of a feeding regimen, it is more likely to be associated with enteral feeding (feeds are too concentrated or delivery rate is too fast, or a combination of both). In this case, the progression of the feeding regimen should be revised and the concentration or rate of delivery decreased. If these measures are insufficient to eliminate the symptom and if there is no other cause found (e.g. infection or change in underlying disease status), then intolerance to the feed formulation should be considered.

If a patient is established on feeding, the feeding formula has not passed its expiry date, and the flow-rate is not excessive, then the feeding formula is unlikely to cause diarrhoea. It is important to determine whether or not antibiotic treatment has recently been commenced, as this is a common cause of diarrhoea. If not, stools should be examined for evidence of an infective cause. If diarrhoea of unknown origin persists, a period of 'bowel rest', using partially or fully predigested protein feeds, may solve the problem. Following this, feeding with polymeric formulas may be re-introduced gradually.

Constipation frequently occurs with all forms of enteral feeding, particularly PEG feeding, because a large number of the patients are on long-term feeding, are immobile, have had strokes and are consequently more likely to have reduced peristalsis. To compound this problem, such patients often have insufficient fluid and dietary fibre intakes. Constipation can be eliminated or diminished, avoiding the discomfort and humiliation of enemas and decreasing expenditure on laxatives. Sometimes, increasing fluid intake to an appropriate level will suffice. Fibre-containing feeds may be administered to provide up to 30 g fibre in a 2 litre feed. The use of the natural laxative, prune juice, if administered as a 30–50 ml dose in the last feed at night, is very effective. Some patients with long-term constipation may be given prophylactic laxatives.

HOME PERCUTANEOUS ENDOSCOPIC GASTROSTOMY

A major advantage of PEG feeding is that its use makes it possible to discharge an increasing number of patients into the community or into nursing homes who, formerly, would have remained dependent on hospital in-patient care. It is crucial that such a transition is well organized, that only suitable patients are selected and, importantly, that the patient is in agreement (Ponsky *et al.* 1989).

Sufficient advance warning is advisable so that community systems can be established in good time. The patient (where possible) and family or carer should be educated about all aspects of PEG feeding and care. They should receive written (and pictorial if necessary) information for reference at home, which should include contact names and telephone numbers for emergency back-up.

The feeding regimen should be suited to the individual's lifestyle and requirements. Mobile young patients of stable weight and condition who have been established on PEG feeding may prefer the PEG feeding button (rather than tube) as it is unobtrusive, thereby enhancing the possibility of leading a more normal lifestyle. Requirements for a pump or other feeding equipment should be determined before discharge so that the patient and the carer(s) can be trained appropriately before the patient goes home. With the consent of the patient, the public health nurse should be alerted and home visits organized. The general practitioner (GP) should be informed of the patient's medical condition and all aspects of PEG and the feeding regimen (preferably in writing), because the GP is often the first person the patient goes to with a problem. The local pharmacy should be contacted to ensure that the necessary feeds and equipment are available.

Financial matters should be considered in advance of discharge. When the patient has a medical card, feeding materials and equipment will be provided free of charge if the items are approved by the General Medical Services (GMS) Scheme in the Republic of Ireland or the Advisory Committee on Borderline Substances (ACBS) in the UK. If the patient does not have a medical card, often refunds may be claimed from the local Health Board (e.g. under the Assistance Towards the Cost of Prescribed Medicine Scheme in the Republic of Ireland). Most patients who need home PEG will qualify for this type of benefit. For patients who are not eligible for such assistance, benefits may be claimed under other schemes, or tax relief may be available on health expenses which have not been reimbursed.

Follow-up care should be organized (if possible) before the patient is discharged from hospital, rather than arranging a review only when problems arise. A routine protocol

for follow-up may prevent some of the avoidable problems and consequent unnecessary distress.

DISCONTINUATION OF PERCUTANEOUS ENDOSCOPIC GASTROSTOMY FEEDING

PEG feeding should be discontinued when oral intake is sufficient, if the enteral route becomes contraindicated, if a patient is terminally ill (when death is imminent), or at the patient's request, in some cases. PEG feeding may be temporarily stopped if the PEG tube is irreversibly damaged, whilst awaiting tube replacement. If a patient is terminally ill, and unfit for endoscopy, or if there is a temporary improvement in oral intake, the tube may remain *in situ* and be cared for in the usual manner (Cullado *et al.* 1990), but will not be used. In certain circumstances, moral or ethical issues may make the decision to continue or to terminate feeding a difficult one. When PEG feeding is no longer required, the tube is removed, usually by an endoscopic method (Wilson *et al.* 1990; Dilorenzo *et al.* 1992).

CONCLUSION

PEG is a reliable, safe and cost-effective method for long-term enteral feeding (Mohandas *et al.* 1992). The insertion procedure is minimally invasive and a PEG tube, if properly cared for, can remain *in situ* for up to 3 years (Dilorenzo *et al.* 1992). This method of feeding allows for an increasing number of hospital patients to be discharged into the community.

However, it is important that patients are carefully selected and that they give informed consent (Clarkson *et al.* 1990). If long-term nutritional support via PEG is to be successful, it is essential that patients and their carers are appropriately educated about PEG feeding and trained in the use of the tube and the necessary equipment. In view of the likely increase in numbers of patients being fed by PEG, the development of general protocols for procedures, feeding regimens and follow-up should be encouraged, for use both in hospitals and in the community. This would diminish confusion for patients and for staff as they move between hospitals.

In considering the use of PEG feeding in patient management, the patient's perspective must also be given credence, a point eloquently made by Lo & Dornbrand (1989): 'It has been asserted that medicine should benefit the patient according to the patient's definition of benefit'.

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