Endoscopic placement of enteral feeding tubes

Gerard P Rafferty, Tony CK Tham

Gerard P Rafferty, Tony CK Tham, Division of Gastroenterology, Ulster Hospital, Dundonald, Belfast BT16 1RH, Northern Ireland, United Kingdom

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Correspondence to: Gerard P Rafferty, MB, BCh, Division of Gastroenterology, Ulster Hospital, Belfast BT16 1RH, Northern Ireland, United Kingdom. gerardrafferty@hotmail.com
 Telephone: +44-28-90293199

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Abstract

Malnutrition is common in patients with acute and chronic illness. Nutritional management of these malnourished patients is an essential part of healthcare. Enteral feeding is one component of nutritional support. It is the preferred method of nutritional support in patients that are not receiving adequate oral nutrition and have a functioning gastrointestinal tract (GIT). This method of nutritional support has undergone progression over recent times. The method of placement of enteral feeding tubes has evolved due to development of new feeding tubes and endoscopic technology. Enteral feeding can be divided into methods that provide short-term and long-term access to the GIT. This review article focuses on the current range of methods of gaining access to the GIT to provide enteral feed.

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INTRODUCTION

Malnutrition and undernutrition

Malnutrition is defined as a state of nutrition in which there is a deficiency or excess of energy, protein and other nutrients causing measurable adverse effects on tissue/body form, function and clinical outcome^[1]. It is recognised that 30% of in-hospital patients are malnourished (undernourished) on admission and the majority of these will lose further weight while in hospital^[2]. Consequences of malnutrition include reduced muscle mass, impaired immune function, poor tissue viability, poor clinical outcome and psychosocial effects^[3]. Enteral feeding is one of the treatment options available to treat malnourished patients and prevent poor outcomes. See Tables 1 and 2 for enteral feeding indications and contraindications.

Hospital patients at risk of malnutrition should be identified by screening methods such as MUST (Malnutrition Universal Screening Tool), SGA (Subjective Global Assessment), MNA (Mini Nutritional Assessment) and or NRS (Nutrition Risk Score). Further nutritional assessment involves dietary history, anthropometrics, biochemical testing, and clinical methods. Patient energy requirements are calculated using: Basal Metabolic Rate equations (e.g. Schofield, Harris Benedict, Ireton Jones), Stress Factors, Combined Factor for Activity Level and Diet Induced Thermogenesis, Weight loss/gain or Physical Activity Levels.

Malnourished patients require nutritional support. This can be provided in different forms including dietary modification, dietary supplements, enteral feeding (standard 1kcal/mL; with or without fibre) or higher energy (1.2-2.0 kcal/mL; with or without fibre) or

parenteral feeding. The development of parenteral nutrition in the 1960's meant that feeding was possible even in patients who did not have a functioning gastrointestinal tract^[4].

Enteral feeding is used to provide either supplementary or complete nutrition to patients who are unable to maintain adequate nutrition by oral route. It is only likely to benefit malnourished patients or those at risk of malnutrition. This includes patients that have had a failed trial of diet modification or supplementary feeds or patients at pulmonary aspiration risk from oral nutrition.

This review will focus on various techniques available for endoscopically placed feeding tubes as a means of delivering enteral feeds to the gastrointestinal tract (GIT).

ENTERAL VERSUS PARENTERAL FEEDING

Enteral feeding is more physiological, less costly and easier to administer than parenteral feeding. Enteral feeding produces GIT luminal contents that can decrease gut atrophy. Maintaining a normal intestinal mucosa reduces the hazard of bacteria and toxins crossing the GIT wall and therefore can decrease proinflammatory mediator levels. Compared with parenteral nutrition, enteral feeding attenuates the acute phase response and improves disease severity in acute pancreatitis^[5]. Hernandez *et al*^[6] have shown that enteral feeds decrease gut mucosal atrophy in critically ill patients. A meta-analysis has shown that in acute pancreatitis, use of EN was associated with a significant reduction in infectious morbidity, hospital length of stay, and a trend toward reduced organ failure when compared with use of parenteral nutrition (PN)^[7]. However it is important to note that many of the studies involving parenteral nutrition had full dose daily calorie intake whereas enteral feeding studies were less likely to reach estimated energy requirements. This is significant since ill stressed patients should not be given full calorie energy requirements in the first 24-48 h of commencing feeding. Therefore the parenteral feeding groups were disadvantaged in that the patients were overfed initially and received excess energy calorie intake. Indeed early parenteral studies reported that outcomes were improved with standard care (intravenous fluids and dextrose) compared with parenteral nutrition^[8]. Complications of enteral feeding can be related directly to tube, formula or pulmonary aspiration^[9]. Enteral tubes can directly damage nose, pharynx or oesophagus. Enteral tubes can also be misplaced intracranially, intra-abdominally or into the tracheobronchial tree. Formula related problems include nausea, vomiting and diarrhea. Nutrient imbalances secondary to enteral feed include hyperglycaemia, electrolyte disturbance, volume overload and refeeding syndrome. See Table 2 for enteral feeding contraindications.

The National Institute of Clinical Excellence states that parenteral nutrition is only to be used in patients with "inadequate or unsafe oral and/or enteral nutritional

Table 1 Enteral feeding indications^[7,4]

Unconscious patient: Head injury, ventilated patient
Swallowing disorder: MS, MND, bulbar and pseudobulbar palsies, huntington's disease, post-stroke (early feeding < 7 d beneficial)
Physiological anorexia: Liver disease
Partial intestinal failure: Postoperative ileus, IBD, short bowel syndrome
Increased nutritional requirements: Cystic fibrosis, renal disease
Psychological problems: Severe depression, anorexia nervosa

Table 2 Enteral feeding relative contraindications^{[7,5]a}

Intestinal obstruction
Ileus
High output small bowel fistula
High doses positive inotropic agents
Hypotension

^aPatients with intestinal failure due to ileus, dysmotility, or subacute obstruction and who cannot tolerate oral intake are recognized to be suitable to receive some form of enteral nutrition.

intake and a non-functional, inaccessible or perforated (leaking) gastrointestinal tract"^[9]. These guidelines also state that PN can be associated with risks due to line placement, infection and thrombosis that do not occur with enteral feeding^[9].

In summary, although the enteral versus parenteral nutrition trials have involved heterogeneous groups of patients and varying types of nutrition, it is recommended that in patients with a functioning gut enteral feeding is preferable to parenteral feeding.

SHORT-TERM ENTERAL FEEDING

Short-term enteral access feeding tubes are typically placed when enteral feeding is expected to be less than 30 d duration^[10]. Pre-pyloric tubes naso-gastric tubes (NG) are the most frequent type of NET used. These NG tubes deliver enteral feed to the stomach reservoir and are the most physiological method of enteral feeding. NG tube placement requires little training and is the preferred method of enteral feeding for the majority of patients provided there is no stomach dysfunction. An additional advantage of NG feeding is that the stomach can tolerate higher feeding rates and increased density feeds compared to post-pyloric feeding. Feeding can be bolus or continuous *via* NG tube. However, general disadvantages of NET tubes include tube dislocation and clogging. They can also cause patient discomfort, irritation, ulceration and bleeding.

NG tube placement: NG tube placement typically occurs at the patient's bedside. The NG tube is negotiated from the naris to be distally placed in stomach. It is typically small diameter NG tubes (5-8 French gauge) that are utilized. The correct position of the NG tube is confirmed by ensuring that the aspirate suctioned has

Table 3 Management of post-pyloric NETs

Flushed immediately after each intermittent feeding bolus infusion
Flushed every 6 to 8 h during continuous feeding
Flushed immediately after installation of any medications
Only use liquid/completely dissolved medications

a pH < 5. The use of a stethoscope to auscultate for gastric gurgling while injecting air will not determine that NG tube is in correct position. A chest X-ray can also be performed to determine definite placement position.

Unfortunately NET tubes are frequently removed accidentally. Reinserting these feeding tubes exposes the patient to risk and consumes hospital resources including replacement time and radiology time. Nasal bridles are easily placed at bedside and essentially fix the NET in position at the naris. A recent small study has suggested that a nasal bridle can prevent NET dislodgement^[11]. Only 10% patients in nasal bridle group had NET displacement versus 36% in the tape group^[11].

Pre-pyloric endoscopic NET placement

Peroral endoscopic NG tube placement: Endoscopic NG tube placement may be valuable if there is any obstruction in the oesophagus (such as oesophageal stricture) that prevents bedside NG tube placement. In these circumstances the gastroscope is passed to the stricture and the NG tube is then passed through the stricture using direct vision. The length of NG tube to be inserted can be estimated by measuring, using a NET placed externally, from the tip of the patient's nose to the earlobe and then to the xiphoid process (sternum)^[12]. Another option for placing pre-pyloric NETs is the use of an ultrathin gastroscope. This small diameter gastroscope is transversed through the oesophageal stricture and allows access to the stomach. A guidewire is then placed through the gastroscope into the stomach and the gastroscope is removed with the guidewire remaining in-situ. A NET tube can then be placed over the guidewire into the stomach. This method however will require a difficult mouth-to-nose transfer step. A further method of peroral NG tube placement is dilation of tight malignant oesophageal strictures using balloon dilatation^[13]. This allows access to the stomach and placement of the NG tube, with a normal gastroscope. However balloon dilatation of malignant oesophageal strictures carries an oesophageal perforation risk of 6.4%^[13].

Transnasal endoscopic NG tube placement: A transnasal method of NG tube placement in oesophageal cancer patients has been described^[14]. The ultrathin gastroscope is used to intubate the oesophagus *via* the nasal cavity and then position the guidewire into the stomach through the oesophageal stricture. The gastroscope is then retracted *via* the nasal cavity. The NG tube is subsequently inserted over the guidewire using fluoroscopic methods. Lin *et al* achieved a 99% success rate of NG placement in oesophageal cancer patients that

had previously failed NG placement. However 30% of the patients required oesophageal stricture dilation, to allow passage of the ultrathin gastroscope, before placement of NG tube^[14].

Post-pyloric endoscopic NET placement

Post-pyloric enteral feeding has a long history and was first described in 1858^[15]. In patients where gastric feeding had failed (large residual gastric volumes, vomiting or regurgitation) post-pyloric NET placement is another option to allow enteral feeding^[16-18]. See Table 3 for management of post-pyloric NETs.

It is known that ill patients can have slow gastric emptying but that small bowel motility is usually preserved. Therefore feeding post-pylorically, in such individuals, may decrease gastro-oesophageal reflux and resulting pulmonary aspiration^[19]. There is however varying data available regarding the risk of pneumonia in prepyloric feeding versus post-pyloric feeding. One meta-analysis showed no significant difference in the rates of pneumonia^[20]. A study in a group of critically ill patients did however show a significantly increased gastro-oesophageal reflux in a pre-pyloric feeding group compared to post-pyloric feeding group. The patients who had gastro-oesophageal reflux also had increased rates of pulmonary aspiration^[21]. Therefore post-pyloric feeding should be considered in patients with gastric feed aspiration, severe gastro-oesophageal reflux, gastrocutaneous fistula or gastroparesis. For Intensive Care Units, the American Society for Parenteral and Enteral Nutrition and the American Society of Critical Care Medicine have revised their guidelines to suggest that gastric residual volume up to 500 mL is allowed and only levels greater than this increase the risk of pulmonary aspiration^[22]. The requirement for post-pyloric feeding in acute severe pancreatitis is debatable. There is evidence that NG feeding has no increased complications compared to NJ feeding in patients with objectively graded severe acute pancreatitis^[23,24].

The decision to use a post-pyloric NET necessitates specific instructions regarding its care. Post-pyloric NETs have smaller diameters than those of pre-pyloric NETs. They are therefore more prone to clogging and blockage. If the post-pyloric NET is placed beyond the Ligament of Treitz pancreatic enzymes may not be released. However, this may result in mal-digestion. Post-pyloric feeding requires prescription of elemental feeds^[4]. Post-pyloric feeding also bypasses the gastric acid and therefore there is increased risk of bacterial contamination. Therefore feeds have to be given as a closed system. Continuous feeding is used since bolus feeding cannot be tolerated by the small bowel lumen^[4].

Non-endoscopic post-pyloric NET placement: The possibility that standard post-pyloric feeding tubes, placed at the bedside, will reach the small bowel is 30%^[25]. A modification of the standard tube is the self-propelling feeding tube. These can be inserted at the bedside. One

Table 4 Endoscopic methods of peroral post-pyloric NET placement

Drag and pull	Sutured distal end of NET is pulled down small bowel using grasping forceps
Over the guidewire	Guidewire placed in small bowel and NET placed over guidewire. Involves difficult oro-pharyngeal exchange
Push technique	NET stiffened using guidewire(s). Grasping forceps used to push into small bowel
Through scope	240 cm NET used to allow exchange. Involves oro-pharyngeal exchange

Table 5 Principles/techniques of post-pyloric NET placement^[67]

Decompress stomach to reduce gastroscope looping within stomach
Liberal lubrication needs to be applied to lower friction between guidewire/NET/gastroscope
A stiff shaft guidewire will help direct NET insertion along longitudinal axis

study, using this type of NET, with air insufflation, intravenous erythromycin and electrocardiogram monitoring of the stomach, achieved an 88% post-pyloric placement in an intensive care setting^[25]. A further study compared spiral and straight-tip post-pyloric NETs^[26]. In those patients with normal gastric emptying, successful placement at 24 h was achieved in 78% (spiral tube) versus 14% (straight tube)^[26]. Unfortunately both of these post-pyloric NET placement techniques require experience and are relatively slow to perform. Post-pyloric NET placement using fluoroscopy is also possible. It does however need radiological equipment and this can result in delays. Post-pyloric tubes that have an electromagnetic tip which can be imaged in real-time are available. Sensors on the lower chest wall are able to image the tip of the NET and provide an image on a mobile screen. This has been shown to eliminate lung placement^[27].

Peroral endoscopic post-pyloric NET placement:

Endoscopic post-pyloric NET placement is a frequent referral to the endoscopy team. Experience of such endoscopic techniques however varies widely among endoscopists. Indeed, training programs are generally lacking in teaching trainee endoscopists the relevant techniques of post-pyloric NET placement.

There are four major different techniques of peroral endoscopic post-pyloric NET placement (See Tables 4 and 5): (1) Drag and pull technique: This is the earliest technique. A suture is placed at the distal tip of the NET. The NET is then passed via naris to the stomach. The gastroscope is then navigated perorally into the stomach. Biopsy forceps grab the suture and drag the NET as far down the small bowel as possible. The grasping forceps are released and the gastroscope is withdrawn slowly. The biopsy forceps release grasp and then re-grasp to keep pushing the NET further down the small bowel

while the gastroscope is retracted. Unfortunately the friction of the gastroscope against the NET often causes retraction of the NET into the stomach on endoscope removal. Indeed it is this difficulty that discourages endoscopists from this technique. One group however has claimed a 93% success rate with this method^[28]. A further technique has been developed that entails using a mucosal clip to attach the distal NET to small bowel wall mucosa^[29]. In this small study this prevented retrograde dislodgement of the NET; (2) Over-the-guidewire technique: The gastroscope is advanced perorally into the small bowel. A guidewire is then advanced down the biopsy channel into the small bowel and the gastroscope is removed leaving the guidewire in-situ. The guidewire exits orally and needs to be changed to achieve nasal exit. A nasopharyngeal catheter is placed via the nose into the pharynx. The distal tip of the catheter is grabbed using forceps to allow the distal end to exit orally. The guidewire is fed through this catheter to exit at the nose. Next the catheter is retracted nasally to leave guidewire in-situ. At this point a NET can be fed over the guidewire to the small bowel; (3) Push technique: The NET is stiffened using 2 guidewires. One 0.052 inch or two 0.035 inch guidewires are placed through the NJ tube without exiting the tip of the tube. This “stiffened” tube is then navigated through the nose and into the stomach. The NET is then grabbed by biopsy forceps and pushed into the small bowel with advancement of the gastroscope^[30]. The stiffened NET is thought less likely to migrate proximally on removal of the endoscope. Wiggins *et al* had a 97.6% successful positioning rate using this technique with a mean procedure time of 11.6 min^[31]. A separate study reported a success rate for NET placement of 94% performed in an average of 12 min^[32]. This preliminary placement of the tube through the nose into the small bowel avoids the difficult oral-nasal transfer; (4) Therapeutic gastroscope method: A small diameter NET can be fed through the biopsy channel of a large diameter therapeutic scope. This allows direct placement the large diameter gastroscope into the small bowel. A 240 centimetre 8 or 10 French gauge NET is placed through the endoscope. The scope is removed once the distal end of the NET is in a suitable position. The extended length of the NET allows the NET to remain in position as the scope is exchanged/removed over the NET. The NET is then cut to the desired length. The next step is an oro-nasal transfer as described above. A feeding adaptor is subsequently placed at the proximal end of the NET. Bosco *et al*^[33] had a 90% success rate, with this technique, with a mean procedure time of 19 min. A separate study reported successful NET placement in the jejunum in 90% of cases with an average procedure time of 15 min^[34].

Transnasal endoscopic post-pyloric NET placement:

A transnasal endoscopic post-pyloric NET placement method has been described in both critically ill and non-

Table 6 Types of endoscopic placed feeding tubes

Short-term enteral feeding	
Pre-pyloric endoscopic NET placement	Peroral pre-pyloric NET Transnasal pre-pyloric NET
Post pyloric endoscopic NET placement	Peroral post-pyloric NET Transnasal post-pyloric NET
Long-term enteral feeding	
Pre-pyloric feeding	Endoscopic PEG
Post-pyloric feeding	Endoscopic PEGJ Endoscopic D-PEJ

critically ill patients. It was first described as a method of viewing the upper gastrointestinal tract (GIT) in 1987^[35]. The advent of small diameter gastroscopes has allowed a transnasal method of post-pyloric NET placement. The technique involves application of intranasal anaesthesia to a patient's nares. One benefit of this method is that no intravenous sedation is required which may be important especially if patient is unwell. This method also negates the need for the difficult mouth to nose wire transfer associated with some peroral NET placement techniques. An ultrathin gastroscope is passed transnasally into the upper GI tract^[36]. The gastroscope is then advanced as far as possible into the duodenum. A soft-tipped guidewire is placed through the working channel. The guidewire is advanced as far as possible into the small bowel. The gastroscope is withdrawn with the guidewire remaining in-situ. The NET is passed over the guidewire which is subsequently removed. Distal NET position is confirmed by fluoroscopy. If NET position is not satisfactory the whole procedure is repeated. Unfortunately, excessive gastric looping of the thin gastroscope is common-especially if altered duodenal anatomy is present. In one study, in a non-critically ill group, only 36.8% had NET placement in the jejunum (the endoscopists had little previous experience) although 86.3% did have post pyloric NET placement^[36]. In a separate study in critically ill patients a 133 cm long small calibre prototype gastroscope was used^[37]. Wildi *et al* had a 93.6% post-pyloric NET placement. The group did however comment that duodenal intubation was a difficult component of the procedure.

There have been very few randomised studies comparing transnasal NET placement versus peroral technique. One randomised trial did show that procedure time and sedation doses were lower in the transnasal group compared to the peroral group^[38]. The post-pyloric NET placement rate was the same in both groups with an overall 85% post-pyloric placement^[38]. The overall NET placement, distal to the Ligament of Treitz, was however only 30% with no significant difference between the groups^[38]. This transnasal method also eliminates the risk of endoscopist finger injury during mouth-to-nose guidewire transfer^[39].

A separate study which compared transnasal versus fluoroscopic NET placement in critically ill patients showed no significant differences between post-pyloric NET placement rates^[40]. 90% of procedures achieved

a post-duodenal bulb placement^[40]. The procedure duration was again shorter in the transnasal group^[40]. The importance of endoscopist experience of previous transnasal endoscopy was highlighted by this study. Jejunal NET placement improved from 60% to 100% between the first and last ten procedures^[40]. Overall however there are conflicting reports regarding actual jejunal NET placement by the transnasal method^[36,38,41].

Double-lumen tube NETs: In patients with gastric outlet obstruction a NET with a proximal port for gastric decompression and a distal port for jejunal feeding may be beneficial. These specialised NETs have an outer gastric decompression tube and a thin inner jejunal feeding tube. The gastric decompression port may decrease vomiting and risks associated with post-pyloric feeding tubes.

LONG-TERM ENTERAL FEEDING

Long-term enteral feeding requires the achievement of permanent access in the stomach or small bowel. Long-term enteral feeding is required if the indication for enteral feeding is likely to be greater than 30 d. The effect of the timing and method of enteral tube feeding for dysphagic stroke patients has been studied in a large multi-centre randomised controlled trial. In the early PEG feeding (versus early NG tube placement) there was an increased risk of death or poor outcome of 7.8% ($P = 0.05$)^[42]. General indications for long-term enteral tube insertion include patients who are unable to adequately meet nutritional requirements orally. Patients also need a functioning gastro-intestinal tract. See Table 6 for specific indications for long-term enteral feeding. It is however important to note that long-term enteral feeding medicalises a normal activity of everyday living. Ideally the decision to place long-term enteral feeding should be taken by the Nutrition Support Team or Percutaneously Placed Enteral Tube Feeding Service^[43]. Each hospital should have a defined referral pathway. The Nutrition Support Team is also responsible for post-procedure and long-term follow up.

Endoscopic PEG placement

Technique: The usual method for PEG tube insertion is the "pull through" method. A routine gastroscopy is performed. Duodenal intubation is performed to ensure there is no gastric outlet obstruction. Two operators are usually involved but one operator PEG insertion is possible and safe^[44]. In the "two operator" method the first operator controls the gastroscope. The gastroscope light is then transilluminated through the anterior abdominal wall. The second operator applies finger pressure on the anterior abdominal wall. This diaphanoscopy should result in indentation of the gastric mucosa. The abdominal wall is then aseptically cleaned. The needle aspiration test is utilized. This technique can decrease the risk of overlying small or large bowel

perforation^[45]. Local anaesthetic is injected along tract into the stomach lumen. Next a short incision is made at the puncture site and a trocar needle is inserted into the stomach lumen. A guidewire is placed *via* trocar into the stomach, grabbed by forceps and then retracted through the mouth while removing the gastroscope. The PEG tube is then attached to the guidewire and is pulled *via* the mouth to the abdominal wall exit site. The external booster should be positioned 1-2 cm from the external abdominal wall. No dressings should be placed at the exit site. The external booster should not be sutured.

There is a significantly lower frequency of regurgitation with PEG compared to NG feeding (20.3% versus 40.7%)^[46]. Another benefit of PEG feeding is that the patient receives higher levels of prescribed enteral feeding^[47].

Sedation: Commonly, conscious sedation is used. Occasionally general anaesthesia may be required if the patient cannot be safely sedated using conscious sedation. In some patients with chronic progressive neuromuscular disease the risk of sedation means that anaesthetist support is required.

Prophylactic antibiotics: The British Society of Gastroenterology guidelines suggest intravenous antibiotics for all patients prior to PEG tube insertion (and jejunostomy tube insertion)^[48]. Commonly, a single dose of intravenous co-amoxiclav is given in the hour before the procedure. Cefuroxime is an alternative but should be avoided, where possible, in regions with a high incidence of *Clostridium difficile* infection or infections due to extended spectrum Beta-lactamase-producing organisms. Patients already receiving broad-spectrum antibiotics do not require additional prophylaxis for PEG. The choice of antibiotic for patients with a history of serious penicillin allergy has not been established but teicoplanin is a logical alternative. One meta-analysis has shown an advantage of one dose of antibiotic previous to PEG insertion^[49]. A further meta-analysis showed that rates of infection post PEG-tube insertion were 8% in the antibiotic prophylaxis group and 26% in the no antibiotic group^[50]. The emergence of Methicillin Resistant *Staphylococcus Aureus* (MRSA) bacteria causing local infection at the PEG tube site has led some centres to reappraise infection prophylaxis. A recent study has revealed that MRSA colonisation increases the risk of PEG site MRSA infection^[51]. Oral MRSA eradication treatment may be beneficial^[52].

Diaphanoscopy and needle aspiration test: The transillumination of gastroscopy light through the abdominal wall was until recently considered essential before proceeding with PEG placement. Recent data has however shown that diaphanoscopy is not essential^[53]. Ponsky *et al* used the negative needle aspiration test as an alternative to diaphanoscopy with no complications recorded. In this method a 5 mL syringe is filled with 5

mL of normal saline. The syringe is then held in continuous aspiration as it is passed into the stomach. If air is aspirated before the needle reaches the stomach this suggests that the needle has passed through an overlying loop of bowel. In this situation PEG insertion is abandoned.

Anticoagulants and antiplatelets: Recent guidelines from the BSG suggest that aspirin can be continued during PEG. Warfarin should be stopped but the possible requirement for low molecular weight heparin depends on whether there is a low or high thromboembolism risk. Clopidogrel should also be stopped but if the cardiac condition is high-risk there is a need to liaise with cardiology specialists^[54].

Repeat gastroscopy to confirm PEG-tube position: There is no requirement for a second pass of the gastroscope to verify position of the internal bumper in the majority of procedures^[55].

When to commence feeding? Early feeding (< 4 h) post PEG insertion has been shown to be safe, well tolerated and reduces cost by reducing hospital stay times^[56]. Interestingly, however, early feeding is rarely practiced and most endoscopists withhold feeding for at least 12 h.

Early dislodgement of PEG-tube (< 2 wk): There is some evidence that immediate replacement of the PEG-tube through the tract is possible^[57]. Pofahl *et al* immediately replaced PEG tubes in patients who had early dislodgement with no complications. However the main risk of blind reinsertion of a replacement tube, in a gastro-cutaneous track that is not adequately mature, is inadvertent insertion into the peritoneal cavity. However, urgent replacement can be attempted either endoscopically or radiologically. If endoscopic replacement is attempted then air insufflation should be avoided to minimise tract disruption. Further treatment options that allow the tract to heal include a period of nasogastric suction with intravenous antibiotics and observation^[58]. Repeat PEG placement can then be considered at D 7-10.

Pre-procedure coagulation parameters: Data suggests that platelets should be greater than 50 000 and international normalised ratio less than 1.4 prior to PEG insertion^[59].

Complications: Data from the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) published in 2008 gave results relating to the cause of all deaths within 30 d post-PEG insertion in all UK hospitals^[60]. Over a one-year period there were 719 deaths. Death was due to cardiovascular disease ($n = 175$), respiratory disease ($n = 508$), central nervous system disease ($n = 358$), renal disease ($n = 38$), and hepatic failure ($n = 11$). In 136 cases (19%) the NCEPOD

expert panel regarded the procedure as futile^[60]. 10% patients required a reversal agent post-procedure which indirectly indicates oversedation^[60]. Other evidence shows that serious complications requiring treatment occur in approximately 1%-4% of PEG-tube insertion cases^[60]. Severe acute complications, such as perforation, serious abdominal haemorrhage or peritonitis, occur in less than 0.5% of cases^[61,62]. PEG tube related complications are more likely to occur in elderly patients with co-morbid illness^[62].

PEG site metastasis: Untreated head and neck cancer patients can develop metastatic disease at the abdominal wall due to PEG-tube placement. In one study this risk was approximately 1%^[63] although the use of an overtube may decrease this risk^[64]. PEG tube metastasis have also occurred in patients with oesophageal adenocarcinoma. Introducer PEG-gastrostomy (or Russell method) may be useful in this situation as there is no PEG-tube journey through the oro-pharynx. If it is expected that the patient is going to undergo surgery with curative intent then techniques that may cause seeding of tumour along the skin puncture site should be avoided.

Button/low-profile PEG: These are usually placed once the PEG tract has formed but can also be inserted in a single step endoscopically. Button PEG-tubes are low profile devices and are less socially stigmatising. They are usually used in young persons who find normal PEG-tube protrusion socially unacceptable. However, button PEG-tubes however need replaced every 6 mo and are also more expensive.

Transnasal PEG-tube placement: Unsedated transnasal PEG placement using small diameter gastroscopes is possible. Results show a PEG placement rate of > 90%^[65,66]. These operators were however skilled in performing diagnostic transnasal gastroscopy.

Endoscopic PEGJ placement

Endoscopic PEGJ placement permits post-pyloric feeding. Theoretically, small bowel feeding decreases the risk of gastro-oesophageal reflux and aspiration. There is however limited evidence regarding this and reported rates of aspiration with PEG-J feeding vary from 17%-60%^[67].

Endoscopic PEGJ placement indications include recurrent aspiration with gastric enteral feeding (either PEG or NG), severe gastric-oesophageal feed reflux, gastroparesis and insufficient gastric remnant after surgery (i.e. not possible to place pre-pyloric feeding access). Therefore in patients who have not tolerated pre-pyloric enteral tube feeding it would seem appropriate to use percutaneous post-pyloric feeding if long-term feeding is required.

Techniques: The first description involved dragging a PEGJ tube *via* a previously formed gastrostomy site. The PEGJ tube was then dragged into the small bowel by

means of a gastroscope and snare/forceps. Unfortunately the PEGJ tube habitually migrated proximally upon removal of the scope and the snare/forceps. More recent techniques allow jejunostomy tubes (J-tube) to be placed through PEG-tubes. The consequence of this is that a smaller diameter feeding tube must be used. This over-the-wire technique necessitates a wire being positioned through the PEG tube into the stomach. The wire is then grabbed by forceps and pulled as far possible into the small bowel using the gastroscope. The gastroscope and forceps are removed with the guidewire remaining in the small bowel. A J-tube is then fed over the guidewire into position. A third technique involves passage of an ultrathin endoscope through a PEG site. The gastroscope is then placed into the small bowel. A guidewire is advanced distally, as far as possible, and the gastroscope removed while keeping the guidewire in place. A gastrojejunal tube is then passed over the guidewire into the small bowel^[68]. A supplementary measure is that the distal end of the PEGJ tube (suture attached) can be secured to the small bowel wall using a hemoclip.

Endoscopic D-PEJ placement

Jejunal feeding tubes can be placed directly into the small bowel. A paediatric colonoscope or an enteroscope is employed since gastroscopes are not long enough to reach the jejunum (unless there has been a prior gastrectomy). When the endoscope reaches the jejunum, diaphanoscopy and finger indentation, is performed. Next the negative needle aspiration test is performed. Access to the small bowel is achieved using a trocar needle. The guidewire is then positioned through the trocar needle. The D-PEJ is then inserted using a "pull" technique as used with PEG insertion. D-PEJ tubes (18-20 French gauge) are larger in diameter than PEG-J tubes (9-12 French gauge). However the expertise required to insert a DPEJ may not be as widely available as that for PEG-J insertion. Repeated intubation of the jejunum may be required to identify possible puncture site. Fluoroscopy may also be required.

In one large retrospective study (307 procedures) the success rate of D-PEJ was 68%^[69]. Failure was mostly due to gastric outlet/small bowel obstruction or inability to perform diaphanoscopy. In this study there was 5% risk of serious adverse events including bowel perforation, jejunal volvuli, major bleeds and aspiration^[69]. 1 death occurred out of the 286 patients in the study.

It is known that obesity has a negative effect on the success rate of DPEJ insertion. In one study where the overall success rate of DPEJ insertion was 81% the success rate in those patients with BMI > 30 kg/m² was only 60%^[70]. Given the increasing obesity epidemic this problem will be of increasing importance. This same study also highlighted increased complications in obese patients.

Studies have shown that D-PEJ tubes have lower rates of reintervention (due to less kinking/clogging/retrograde jejunal tube migration) and increased tube longevity compared to PEGJ^[71,72]. In one study the reintervention

rate was as high as 75% for PEGJ, compared to 31% for DPEJ^[73].

CONCLUSION

Malnutrition and undernutrition are common in hospitals. The methods that we have to screen and treat malnutrition have improved greatly over recent times. Parenteral nutrition is a viable option in patients who require nutrition but have a non-functioning gastrointestinal tract. Numerous methods have evolved which aim to achieve GIT access to allow enteral feeding. The development of hospital nutrition teams with specialist interest in enteral feeding will allow enteral feeding in a wider group of patients. The advanced technology that allows many methods of enteral feeding is important but the implementation of these methods is also vital. Enteral feeding should be patient centred and individualized for each patient.

REFERENCES

- 1 **Meier R**, Stratton R. Basic concepts in nutrition: Epidemiology of malnutrition. *e-SPEN* 2008; **3**: 167-170
- 2 **Corish CA**, Kennedy NP. Protein-energy undernutrition in hospital in-patients. *Br J Nutr* 2000; **83**: 575-591
- 3 **Elia M**, Stratton RJ. How much undernutrition is there in hospitals? *Br J Nutr* 2000; **84**: 257-259
- 4 **O'Keefe SJD**, Jones R, Vela CP. A Guide to Enteral Access Procedures and Enteral Nutrition. Viewed 01/05/2009. Available from: URL: <http://cme.medscape.com/view-article/590541>
- 5 **Windsor AC**, Kanwar S, Li AG, Barnes E, Guthrie JA, Spark JI, Welsh F, Guillou PJ, Reynolds JV. Compared with parenteral nutrition, enteral feeding attenuates the acute phase response and improves disease severity in acute pancreatitis. *Gut* 1998; **42**: 431-435
- 6 **Hernandez G**, Velasco N, Wainstein C, Castillo L, Buggedo G, Maiz A, Lopez F, Guzman S, Vargas C. Gut mucosal atrophy after a short enteral fasting period in critically ill patients. *J Crit Care* 1999; **14**: 73-77
- 7 **McClave SA**, Chang WK, Dhaliwal R, Heyland DK. Nutrition support in acute pancreatitis: a systematic review of the literature. *JPEN* 2006; **30**: 143-156
- 8 **McClave SA**, Martindale RG, Vanek VW, McCarthy M, Roberts P, Taylor B, Ochoa JB, Napolitano L, Cresci G. Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). *JPEN* 2009; **33**: 277-316
- 9 National Institute Clinical Excellence. Nutrition Support For Adults. Oral Nutrition Support, Enteral tube nutrition and Parenteral Feeding. Viewed 01/04/2009. Available from: URL: <http://www.nice.org.uk/nicemedia/live/10978/29981/29981.pdf>
- 10 **Kirby DF**, DeLegge MH, Fleming CR. American Gastroenterological Association technical review on tube feeding for enteral nutrition. *Gastroenterology* 1995; **108**: 1282-1301
- 11 **Gunn SR**, Early BJ, Zenati MS, Ochoa JB. Use of a nasal bridle prevents accidental nasoenteral feeding tube removal. *JPEN* 2009; **33**: 50-54
- 12 **Meguid MM**, Eldar S, Wahba A. The delivery of nutritional support. A potpourri of new devices and methods. *Cancer* 1985; **55**: 279-289
- 13 **Quine MA**, Bell GD, McCloy RF, Matthews HR. Prospective audit of perforation rates following upper gastrointestinal endoscopy in two regions of England. *Br J Surg* 1995; **82**: 530-533
- 14 **Lin CH**, Liu NJ, Lee CS, Tang JH, Wei KL, Yang C, Sung KF, Cheng CL, Chiu CT, Chen PC. Nasogastric feeding tube placement in patients with esophageal cancer: application of ultrathin transnasal endoscopy. *Gastrointest Endosc* 2006; **64**: 104-107
- 15 **Adams MB**, Seabrook GR, Quebbeman EA, Condon RE. Jejunostomy. A rarely indicated procedure. *Arch Surg* 1986; **121**: 236-238
- 16 **Vanek VW**. Ins and outs of enteral access. Part 1: short-term enteral access. *Nutr Clin Pract* 2002; **17**: 275-283
- 17 **Montecalvo MA**, Steger KA, Farber HW, Smith BF, Dennis RC, Fitzpatrick GF, Pollack SD, Korsberg TZ, Birkett DH, Hirsch EF. Nutritional outcome and pneumonia in critical care patients randomized to gastric versus jejunal tube feedings. The Critical Care Research Team. *Crit Care Med* 1992; **20**: 1377-1387
- 18 **Hadfield RJ**, Sinclair DG, Houldsworth PE, Evans TW. Effects of enteral and parenteral nutrition on gut mucosal permeability in the critically ill. *Am J Respir Crit Care Med* 1995; **152**: 1545-1548
- 19 **Dive A**, Moulart M, Jonard P, Jamart J, Mahieu P. Gastrointestinal motility in mechanically ventilated critically ill patients: a manometric study. *Crit Care Med* 1994; **22**: 441-447
- 20 **Marik PE**, Zaloga GP. Gastric versus post-pyloric feeding: a systematic review. *Crit Care* 2003; **7**: R46-R51
- 21 **Heyland DK**, Drover JW, MacDonald S, Novak F, Lam M. Effect of postpyloric feeding on gastroesophageal regurgitation and pulmonary microaspiration: results of a randomized controlled trial. *Crit Care Med* 2001; **29**: 1495-1501
- 22 **Martindale RG**, McClave SA, Vanek VW, McCarthy M, Roberts P, Taylor B, Ochoa JB, Napolitano L, Cresci G. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine and American Society for Parenteral and Enteral Nutrition: Executive Summary. *Crit Care Med* 2009; **37**: 1757-1761
- 23 **Eatock FC**, Chong P, Menezes N, Murray L, McKay CJ, Carter CR, Imrie CW. A randomized study of early nasogastric versus nasojejunal feeding in severe acute pancreatitis. *Am J Gastroenterol* 2005; **100**: 432-439
- 24 **Eatock FC**, Brombacher GD, Steven A, Imrie CW, McKay CJ, Carter R. Nasogastric feeding in severe acute pancreatitis may be practical and safe. *Int J Pancreatol* 2000; **28**: 23-29
- 25 **Slagt C**, Innes R, Bihari D, Lawrence J, Shehabi Y. A novel method for insertion of post-pyloric feeding tubes at the bedside without endoscopic or fluoroscopic assistance: a prospective study. *Intensive Care Med* 2004; **30**: 103-107
- 26 **Lai CW**, Barlow R, Barnes M, Hawthorne AB. Bedside placement of nasojejunal tubes: a randomised-controlled trial of spiral- vs straight-ended tubes. *Clin Nutr* 2003; **22**: 267-270
- 27 **Ackerman MH**, Mick DJ. Technologic approaches to determining proper placement of enteral feeding tubes. *AACN Adv Crit Care* 2006; **17**: 246-249
- 28 **Stark SP**, Sharpe JN, Larson GM. Endoscopically placed nasoenteral feeding tubes. Indications and techniques. *Am Surg* 1991; **57**: 203-205
- 29 **Faigel DO**, Kadish SL, Ginsberg GG. The difficult-to-place feeding tube: successful endoscopic placement using a mucosal clip. *JPEN* 1996; **20**: 306-308
- 30 **Hudspeth DA**, Thorne MT, Meredith JW. A simple endoscopic technique for nasoenteric feeding tube placement. *J Am Coll Surg* 1995; **180**: 229-230
- 31 **Wiggins TF**, DeLegge MH. Evaluation of a new technique for endoscopic nasojejunal feeding-tube placement. *Gastrointest Endosc* 2006; **63**: 590-595
- 32 **Patrick PG**, Marulendra S, Kirby DF, DeLegge MH. Endoscopic nasogastric-jejunal feeding tube placement in critically ill patients. *Gastrointest Endosc* 1997; **45**: 72-76
- 33 **Bosco JJ**, Gordon F, Zelig MP, Heiss F, Horst DA, Howell

- DA. A reliable method for the endoscopic placement of a nasoenteric feeding tube. *Gastrointest Endosc* 1994; **40**: 740-743
- 34 **Brandt CP**, Mittendorf EA. Endoscopic placement of nasojejunal feeding tubes in ICU patients. *Surg Endosc* 1999; **13**: 1211-1214
- 35 **Johnson DA**, Cattau EL Jr, Khan A, Newell DE, Chobanian SJ. Fiberoptic esophagogastrosocopy via nasal intubation. *Gastrointest Endosc* 1987; **33**: 32-33
- 36 **Mahadeva S**, Malik A, Hilmi I, Qua CS, Wong CH, Goh KL. Transnasal endoscopic placement of nasoenteric feeding tubes: outcomes and limitations in non-critically ill patients. *Nutr Clin Pract* 2008; **23**: 176-181
- 37 **Wildi SM**, Gubler C, Vavricka SR, Fried M, Bauerfeind P. Transnasal endoscopy for the placement of nasoenteral feeding tubes: does the working length of the endoscope matter? *Gastrointest Endosc* 2007; **66**: 225-229
- 38 **Külling D**, Bauerfeind P, Fried M. Transnasal versus transoral endoscopy for the placement of nasoenteral feeding tubes in critically ill patients. *Gastrointest Endosc* 2000; **52**: 506-510
- 39 **Sivak MV Jr**. The nose: is this the route to improving esophagogastroduodenoscopy? *Gastrointest Endosc* 1999; **49**: 395-358
- 40 **Fang JC**, Hilden K, Holubkov R, DiSario JA. Transnasal endoscopy vs. fluoroscopy for the placement of nasoenteric feeding tubes in critically ill patients. *Gastrointest Endosc* 2005; **62**: 661-666
- 41 **Dranoff JA**, Angood PJ, Topazian M. Transnasal endoscopy for enteral feeding tube placement in critically ill patients. *Am J Gastroenterol* 1999; **94**: 2902-2904
- 42 **Dennis MS**, Lewis SC, Warlow C. Effect of timing and method of enteral tube feeding for dysphagic stroke patients (FOOD): a multicentre randomised controlled trial. *Lancet* 2005; **365**: 764-772
- 43 The Provision of a Percutaneously Placed Enteral Tube Feeding Service. British Society Gastroenterology. Guidelines in process, 2010
- 44 **Rimon E**. The safety and feasibility of percutaneous endoscopic gastrostomy placement by a single physician. *Endoscopy* 2001; **33**: 241-244
- 45 **Schrag SP**, Sharma R, Jaik NP, Seamon MJ, Lukaszczuk JJ, Martin ND, Hoey BA, Stawicki SP. Complications related to percutaneous endoscopic gastrostomy (PEG) tubes. A comprehensive clinical review. *J Gastrointest Liver Dis* 2007; **16**: 407-418
- 46 **McClave SA**, Lukan JK, Stefater JA, Lowen CC, Looney SW, Matheson PJ, Gleeson K, Spain DA. Poor validity of residual volumes as a marker for risk of aspiration in critically ill patients. *Crit Care Med* 2005; **33**: 324-330
- 47 **Norton B**, Homer-Ward M, Donnelly MT, Long RG, Holmes GK. A randomised prospective comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding after acute dysphagic stroke. *BMJ* 1996; **312**: 13-16
- 48 **Allison MC**, Sandoe JA, Tighe R, Simpson IA, Hall RJ, Elliott TS. Antibiotic prophylaxis in gastrointestinal endoscopy. *Gut* 2009; **58**: 869-880
- 49 **Sharma VK**, Howden CW. Meta-analysis of randomized, controlled trials of antibiotic prophylaxis before percutaneous endoscopic gastrostomy. *Am J Gastroenterol* 2000; **95**: 3133-3136
- 50 **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**: 647-656
- 51 **Mainie I**, Loughrey A, Watson J, Tham TC. Percutaneous endoscopic gastrostomy sites infected by methicillin-resistant *Staphylococcus aureus*: impact on outcome. *J Clin Gastroenterol* 2006; **40**: 297-300
- 52 **Thomas S**, Cantrill S, Waghorn DJ, McIntyre A. The role of screening and antibiotic prophylaxis in the prevention of percutaneous gastrostomy site infection caused by methicillin-resistant *Staphylococcus aureus*. *Aliment Pharmacol Ther* 2007; **25**: 593-597
- 53 **Ponsky JL**. Transilluminating percutaneous endoscopic gastrostomy. *Endoscopy* 1998; **30**: 656
- 54 **Veitch AM**, Baglin TP, Gershlick AH, Harnden SM, Tighe R, Cairns S. Guidelines for the management of anticoagulant and antiplatelet therapy in patients undergoing endoscopic procedures. *Gut* 2008; **57**: 1322-1329
- 55 **Sartori S**, Trevisani L, Nielsen I, Tassinari D, Abbasciano V. Percutaneous endoscopic gastrostomy placement using the pull-through or push-through techniques: is the second pass of the gastroscope necessary? *Endoscopy* 1996; **28**: 686-688
- 56 **McCarter TL**, Condon SC, Aguilar RC, Gibson DJ, Chen YK. Randomized prospective trial of early versus delayed feeding after percutaneous endoscopic gastrostomy placement. *Am J Gastroenterol* 1998; **93**: 419-421
- 57 **Pofahl WE**, Ringold F. Management of early dislodgment of percutaneous endoscopic gastrostomy tubes. *Surg Laparosc Endosc Percutan Tech* 1999; **9**: 253-256
- 58 **Marshall JB**, Bodnarchuk G, Barthel JS. Early accidental dislodgement of PEG tubes. *J Clin Gastroenterol* 1994; **18**: 210-212
- 59 **Fang J**. Percutaneous Access for Enteral Nutrition. Techniques. *Gastrointest Endosc* 2007; **3**: 176-182
- 60 **Johnston SD**, Tham TC, Mason M. Death after PEG: results of the National Confidential Enquiry into Patient Outcome and Death. *Gastrointest Endosc* 2008; **68**: 223-227
- 61 **Löser C**, Aschl G, Hébuterne X, Mathus-Vliegen EM, Muscaritoli M, Niv Y, Rollins H, Singer P, Skelly RH. ESPEN guidelines on artificial enteral nutrition--percutaneous endoscopic gastrostomy (PEG). *Clin Nutr* 2005; **24**: 848-861
- 62 **Raha SK**, Woodhouse K. The use of percutaneous endoscopic gastrostomy (PEG) in 161 consecutive elderly patients. *Age Ageing* 1994; **23**: 162-163
- 63 **Cruz I**, Mamel JJ, Brady PG, Cass-Garcia M. Incidence of abdominal wall metastasis complicating PEG tube placement in untreated head and neck cancer. *Gastrointest Endosc* 2005; **62**: 708-711; quiz 752, 753
- 64 **Couto G**. Overtube for preventing abdominal-wall metastasis after PEG-tube placement. *Gastrointest Endosc* 2006; **63**: 1087
- 65 **Dumortier J**, Lapalus MG, Pereira A, Lagarrigue JP, Chavillon A, Ponchon T. Unsedated transnasal PEG placement. *Gastrointest Endosc* 2004; **59**: 54-57
- 66 **Vitale MA**, Villotti G, D'Alba L, De Cesare MA, Frontespezi S, Iacopini G. Unsedated transnasal percutaneous endoscopic gastrostomy placement in selected patients. *Endoscopy* 2005; **37**: 48-51
- 67 **DiSario JA**. Endoscopic approaches to enteral nutritional support. *Best Pract Res Clin Gastroenterol* 2006; **20**: 605-630
- 68 **Adler DG**, Gostout CJ, Baron TH. Percutaneous transgastric placement of jejunal feeding tubes with an ultrathin endoscope. *Gastrointest Endosc* 2002; **55**: 106-110
- 69 **Maple JT**, Petersen BT, Baron TH, Gostout CJ, Wong Kee Song LM, Buttar NS. Direct percutaneous endoscopic jejunostomy: outcomes in 307 consecutive attempts. *Am J Gastroenterol* 2005; **100**: 2681-2688
- 70 **Mackenzie SH**, Haslem D, Hilden K, Thomas KL, Fang JC. Success rate of direct percutaneous endoscopic jejunostomy in patients who are obese. *Gastrointest Endosc* 2008; **67**: 265-269
- 71 **Krivian K**, Peterson KP, DiSario JA, Fang J. Comparison of percutaneous endoscopic gastrostomy with jejunal extension to combined direct percutaneous endoscopic gastrostomy/direct percutaneous endoscopic jejunostomy. *Gastrointest Endosc* 2004; **59**: AB158
- 72 **DeLegge M**, McClave S, Ginsberg G, Fang J, Disario J. Randomized prospective comparison of direct percutaneous endoscopic jejunostomy vs. percutaneous endoscopic gastrostomy with jejunal extension feeding tube placement for enteral feeding. *Gastrointest Endosc* 2004; **59**: AB158
- 73 **Delegge M**, Buck G, Fang J. Randomized Prospective

- Comparison of Direct Percutaneous Endoscopic Jejunoscopy (DPEJ) Feeding Tube Placemnt Versus Percutaneous Endoscopic Gastrostomy Feeding Tube Placement with Jejunal Extension (PEGJ), for Enteral Feeding. *Gastrointest Endosc* 2006; **63**: AB160
- 74 **Stroud M**, Duncan H, Nightingale J. Guidelines for enteral feeding in adult hospital patients. *Gut* 2003; **52** Suppl 7: vii1-vii12
- 75 **Pearce CB**, Duncan HD. Enteral feeding. Nasogastric, nasojejunal, percutaneous endoscopic gastrostomy, or jejunostomy: its indications and limitations. *Postgrad Med J* 2002; **78**: 198-204

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