Gastroenterology

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Nutritional support: indications and techniques

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Individuals with disease-related malnutrition are likely to have a poorer clinical outcome than well nourished individuals. The clinical benefits of nutrition support have now been demonstrated in many different conditions, even when frank malnutrition is not present. This article will present the current indications for nutrition support and the techniques available as nutritional therapy.

What is the problem?

Malnutrition in hospitals is frequently not recognised or not addressed as a clinical priority. There may be some uncertainty about its definition, but a landmark study from Dundee demonstrated that malnutrition is common, with a 40% prevalence on admission to hospital[1]. In addition, while in hospital 78% of all patients lost weight during their stay[1].

What are the causes?

Malnutrition is multifactorial (Table 1), with poor intake central in its development. Hospital food and further nutrition support should be seen as part of the patient's treatment rather than a hotel service[3].

Which patients may benefit from nutrition support?

Three groups of patients may be considered for nutrition support (Table 2). The difficulty lies in identifying the correct patients. In general, severely malnourished patients are recognised and referred, but those who are moderately malnourished or at risk of developing malnutrition are poorly recognised.

Nutrition support techniques

Four main nutrition support techniques are available (Table 3):

- Food fortification
- Supplementary enteral tube feeding
- Total enteral tube feeding
- Parenteral nutrition.

An algorithm providing a system for choosing the most appropriate feeding method for patients requiring nutrition support is presented in Fig 1.

Food fortification and oral supplements

Food fortification is a simple and cost-effective way of improving a patient's intake without the need to increase oral intake: for example, the simple addition of cream and butter to food can increase energy intake by 16% and body weight by 5%[4].

If food fortification is insufficient, nutritional supplements should be considered. These products (Table 4) can be prescribed and should be regarded in the same way as medication. They need to be used appropriately, preferably in conjunction with dietetic monitoring. A recent study highlighted that 30% of patients had no documentation recording why the supplement was prescribed, with 36% of supplements being given inappropriately (ie low albumin)[5].

If food fortification and supplements are ineffective or unlikely to be sufficient to affect a patient's nutritional status, artificial enteral nutrition support should be considered.

Supplementary enteral tube feeding

Many patients may be able to meet their nutritional requirements partially by the oral route with normal diet and supplements but may require supplementary

Key Points

- Malnutrition in hospitals is frequently not recognised and has clinical and financial implications
- It is important to select the correct route for nutritional support
- Gastrostomy feeding is a safe and effective way of providing long-term nutritional support
- Parenteral nutrition should be used only in patients with intestinal failure who are unable to meet their nutritional needs via the GI tract
- Parenteral nutrition should be supervised by a multidisciplinary support team

KEY WORDS: enteral feeding, enteral nutrition, gastrostomies, jejunostomy, malnutrition, nasogastric and total parenteral nutrition (TPN), nutrition support, parenteral nutrition, tube feeding

Table 1. Causes of disease-related malnutrition (adapted from Green *et al*[2]).

Category	Cause	Examples
Reduced food intake	Anorexia	Poor appetite, nausea or vomiting as a result of the disease process, treatment or depression
	Episodes of fasting	Prior to investigative procedures or operations, missed meals due to these procedures, or avoidance of food due to diarrhoea and taste changes
	Pain	Sore mouth and reduction in saliva production due to the disease process or treatments, or partial intestinal obstruction
	Swallowing difficulties	Dysphagia and odynophagia
	Inability to eat independently	Physical handicap, arthritis, dementia, visual impairment
	Respiratory problems	Pulmonary disease
Malabsorption	Impaired digestion	Pancreatic insufficiency, enzyme deficiencies, intestinal pH alteration
	Impaired absorption	Intestinal resection, mucosal damage
	Excess losses from the gut	High output stoma and fistulae, protein-losing enteropathy, short bowel syndrome
Modified metabolism	Metabolic response to disease resulting in changes in nutrient mobilisation and utilisation	Malignancy, trauma, chronic sepsis, multiple organ failure, advanced HIV infection
	Metabolic consequences of impaired organ function	Renal disease, liver disease, pulmonary disease

enteral nutrition to achieve a target intake. Nocturnal enteral feeding is of particular value both in the hospital and the home setting, with the advantage that ambulatory patients are not confined to pump feeding during the day. The clinical value of this approach has been demonstrated in elderly malnourished women with fractured neck of femur[6].

Total enteral tube feeding

Total enteral tube feeding may be either short-term or long-term and given by either the intragastric or postpyloric route.

Short-term nasogastric feeding

Nasogastric (NG) feeding is the most common route used in hospitals. The main indication is dysphagia secondary to:

- cerebrovascular accident
- cerebral palsy
- motor neurone disease
- multiple sclerosis
- cerebral injury
- head and neck cancer
- (occasionally) oesophageal cancer.

NG feeding is also often initiated to prevent malnutrition rather than for treatment, or simply to treat malnutrition, without the presence of dysphagia, for example in patients with:

- cystic fibrosis
- Crohn's disease
- chronic obstructive pulmonary disease
- malignancy
- congestive heart failure
- HIV.

The position of the tube can be determined using pH-sensitive paper, which avoids a chest X-ray. This is also important if there is concern about possible malposition, for example if coughing, retching or respiratory distress occurs[7,8].

For aesthetic and body image reasons, some patients may wish to re-pass an NG tube on themselves every night for overnight feeding, removing it during the day. They can be taught how to do this during their hospital stay or at an outpatient visit.

Contraindications to NG feeding include total blockage of the oesophagus or high gastric aspirates that increase the risk of aspiration.

Early enteral feeding. A recent meta-analysis of enteral feeding regimens following gastrointestinal (GI) surgery demonstrates that early feeding may be of benefit, and that there is certainly no advantage in keeping patients nil by mouth after elective GI resection[9].

Table 2. Indications for nutrition support.

Group	BMI	Weight loss (%)	Description
Severely malnourished	<16	>20	Marked weight loss and muscle wasting
Moderately malnourished	16–19	10–20	Reduced intake in the past month, low nutritional parameters
Normal/near normal nutritional status	20–25	<5	Patients at risk of developing malnutrition due to disease or illness

BMI = body mass index.

Short-term nasoduodenal/ nasojejunal feeding

It may be advantageous to infuse feed beyond the pylorus into the duodenum or jejunum in patients at risk of regurgitation and aspiration (eg post-abdominal surgery, gastric atony or gastroparesis). The optimal position is in the proximal jejunum just distal to the ligament of Treitz. The administration of metoclopramide or erythromycin as prokinetic agents can assist the passage of the tube tip past the pylorus. Single lumen tubes have the advantage of being fine bore and thus more suited to the conscious patient. Dual lumen tubes allow concurrent drainage of gastric aspirates and postpyloric feeding, but they have a larger outer diameter and are more suited for the sedated patient, often in the intensive care setting. Placement of these tubes may be performed during surgery, endoscopically or using a bedside technique with either a weighted tube[10] or a coiled tube[11]. There is recent evidence that tubes with a coil near the tip stay in position longer[11].

This mode of feeding can be successful in acute pancreatitis where previously total parenteral nutrition has been used[12]. In addition, postpyloric feeding may be considered in patients with gastric stasis or gastric outlet obstruction, provided that a tube can be passed beyond the obstruction. Recent reports describe the use of these tubes in patients with hyperemesis gravidarum[13].

Complications of enteral feeding (Table 5) are rarely life-threatening and can be easily managed.

Long-term gastrostomy feeding

When feeding is required for longer than one month it is advantageous to have a more permanent feeding gastrostomy tube which can be inserted surgically, endoscopically or radiologically.

Surgical gastrostomy tubes. These tubes are usually placed during a surgical procedure and retained internally by a water filled balloon. Their advantage is that they are easily removed and replaced, but they are prone to leakage

Table 3. Nutrition support techniques.

Route	Method	
Food fortification		Diet advice and oral supplements
Supplementary enteral tube feeding		Nasogastric
Total enteral tube feeding	Short-term	Nasogastric and nasojejunal
	Long-term	Nasogastric (self intubation) PEG, PEGJ, direct PEJ
Parenteral nutrition	Short-term	Peripheral parenteral nutrition Central parenteral nutrition
	Medium-term	Peripherally inserted central catheters Central parenteral nutrition
	Long-term and home	Central parenteral nutrition

PEG = percutaneous endoscopic gastrostomy; PEGJ = percutaneous endoscopic gastro-jejunostomy; PEJ = percutaneous endoscopic jejunostomy.

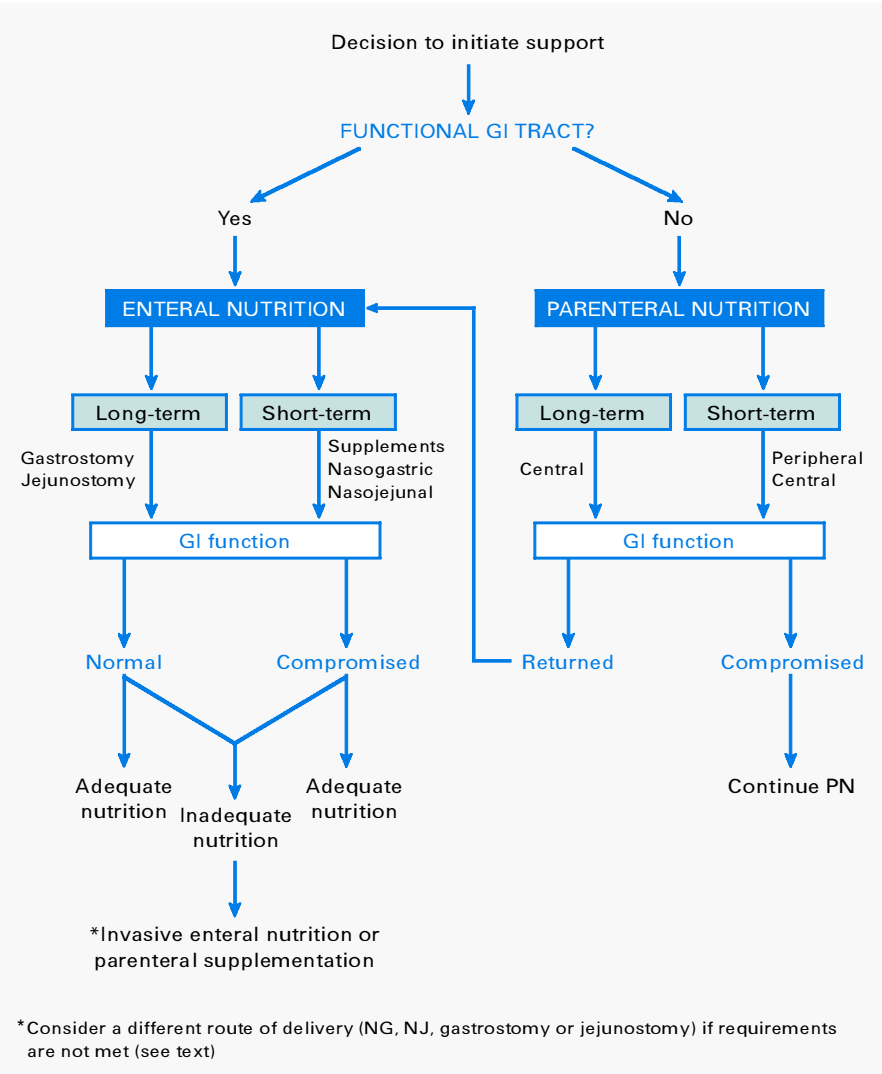

Fig 1. Algorithm for the delivery of enteral and parenteral nutrition (PN) (GI = gastrointestinal; NG = nasogastric; NJ = nasojejunal).

Table 4. Food fortification and oral nutritional supplements.

Type	Product example
Milk based	Fortisip, Ensure Plus, Fresubin, Clinutren 1.5, Resource, Scandishake
Fruit based	Fortijuce, Enlive, Provide Extra, Clinutren Fruit
Glucose powder	Polycose, Maxijul, Polycal
Fat emulsion	Calogen

Table 5. Complications of external tube insertion and feeding.

Complication	Tube type	Possible solution
Tube misplacement	NG, NJ	Check placement with pH-sensitive paper If still uncertain, chest X-ray
Nasal/oesophageal ulceration	NG, NJ	Use fine bore tube (gauge <12) Avoid using a Ryles tube Feeding: >10 days PVC tube <10 days polyurethane tube
Tube blockage	All	Adequate flushing before and after feeding and drug administration
Tube displacement	NG, NJ	Secure tube to nose and face with good adhesive tape Staff awareness (during physiotherapy or handling)
Drug-nutrient interactions	All	Phenytoin absorption reduced if given during enteral feeding Tetracycline absorption decreased by dairy products (70–80%) Levodopa absorption altered by feed protein content **Seek advice from a pharmacist**
Diarrhoea	All	Concurrent antibiotic use Bacterial contamination of feed (ensure good handling technique when manipulating feeding system)
Aspiration	All	Position patient at 30° angle during feeding Aspirate residual volumes from the stomach

NG = nasogastric; NJ = nasojejunal.

and have a lifespan of less than three months.

Percutaneous endoscopic gastrostomy. The most frequently used method of gastrostomy placement now is percutaneous endoscopic gastrostomy (PEG). The indications for insertion are shown in Table 6. The use of PEG has dramatically increased over the past decade due to the simplicity of the technique, increased awareness and availability.

Ethical issues regarding PEG placement should not be overlooked and it is important that the potential benefit for any patient is considered alongside the risk of complications[14]. Where possible, the patient's consent must be obtained; if this is not possible, the patient's best interest should be considered. The decision needs to be discussed with close family and healthcare professionals, and requires time. Recent studies show that 20–30% of patients die within 30 days of PEG insertion. This does not reflect complications of the procedure but simply that many PEGs are inserted in severely ill patients. It is therefore important that patients are correctly selected for the procedure.

Contraindications to PEG insertion can be considered according to:

- *Procedural risk:* high-risk conditions include current chest infection, active gastric ulceration, uncorrected coagulopathy, gross ascites and peritonitis.
- *Chronic diseases:* insertion may be influenced by chronic diseases such as portal hypertension, dementia, Crohn's disease and persistent vegetative state.
- *Technical issues:* proximal GI obstruction, multiple upper abdominal operations and gastrectomy are examples of technical issues that may affect insertion.

Many of these contraindications are relative. As practice varies across the UK, as well as across Europe, they should be considered according to the risk-benefit to the individual patient.

Percutaneous radiological gastrostomy. In the situation in which placement using an endoscope is difficult, percutaneous radiological gastrostomy may be used. In this technique, a gastrostomy tube is placed under ultrasound guidance.

Low profile (button) gastrostomy. Low profile gastrostomy devices (Fig 2) can be used in patients where a more aesthetically pleasing tube is required. They are inserted through a well-established gastrostomy stoma site but require changing more frequently.

Long-term jejunal feeding

Long-term jejunal feeding can be achieved by placing a small jejunal feeding tube through a specially designed PEG and manipulating it into the jejunum using an endoscope. This is termed a percutaneous endoscopic gastro-jejunostomy (PEGJ). More recently, the placement of feeding tubes directly into the jejunum has been described using an endoscopic technique (direct PEJ), as well as the more traditional technique of placing a needle catheter jejunostomy.

Indications for long-term jejunal feeding include patients with gastric stasis or outlet obstruction. Contra-

Table 6. Indications for percutaneous endoscopic gastrostomy insertion.

Indication	Condition	Comment
Swallowing disorders	Cerebrovascular accident Motor neurone disease Other progressive neurological disorders affecting swallowing	Ensure the patient has no underlying infection
Malignancy	Head and neck	
	Oesophageal	Consider for early disease, but radiological insertion may be better to prevent seeding of malignant cells
Malnutrition	See Table 1	For patients who require long-term nutrition support
Venting	Visceral myopathy or neuropathy Autonomic neuropathy	To decompress the stomach in patients with a motility disorder

indications to the procedure are the same as for PEG. It is important to use tubes specifically designed for feeding rather than Foley catheters which tend to leak causing skin irritation and have a shortened lifespan.

Parenteral nutrition

Parenteral nutrition involves the delivery of nutrition directly into the bloodstream. This should be used only in patients with intestinal failure who are unable to meet their nutritional needs via the GI tract. In addition, there is now growing evidence that a nutrition team should be directly involved with patient selection, implementation and delivery of parenteral nutrition. It is well documented that the institution of a hospital nutrition team decreases both its inappropriate use and complication rates[15]. The core elements of a nutrition team include a doctor (physician and/or surgeon), nutrition nurse specialist, dietician and pharmacist. At present 43% of hospitals in the UK have a nutrition support team.

The routes available depend on the anticipated length of feeding (Fig 1).

Parenteral feeding catheters

Parenteral feeding may be given centrally or peripherally:

- *Central parenteral nutrition* (CPN) may be given via a large central vein (subclavian, jugular, cephalic or femoral) or a medium-sized peripheral vein (brachial).
- *Peripherally inserted central catheters* have gained popularity in recent years for short-term CPN but require a large peripheral vein.

Peripheral parenteral nutrition (PPN) may be performed via a medium-sized vein (brachial) or a small vein (forearm or back of the hand). Parenteral nutrition catheter insertion guidelines have been published by the British Association of Parenteral and Enteral Nutrition (BAPEN) (Table 7)[16].

Short-term parenteral feeding

Postoperative and intensive care patients form the majority of those who require short-term parenteral feeding. In these situations, it is recommended that a dedicated single lumen catheter is placed, ideally tunnelled to the anterior chest wall. However, it is possible to feed using a double or triple lumen catheter where one lumen is designated solely for the administration of parenteral nutrition.

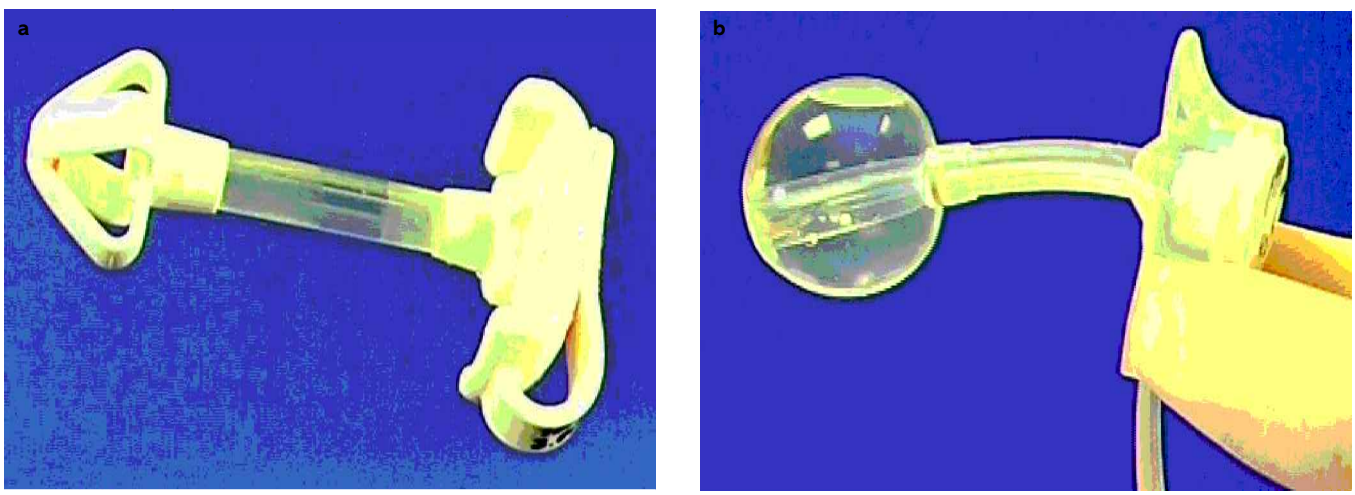

Fig 2. Low profile (button) gastrostomy tubes: (a) with plastic flange; (b) with balloon.

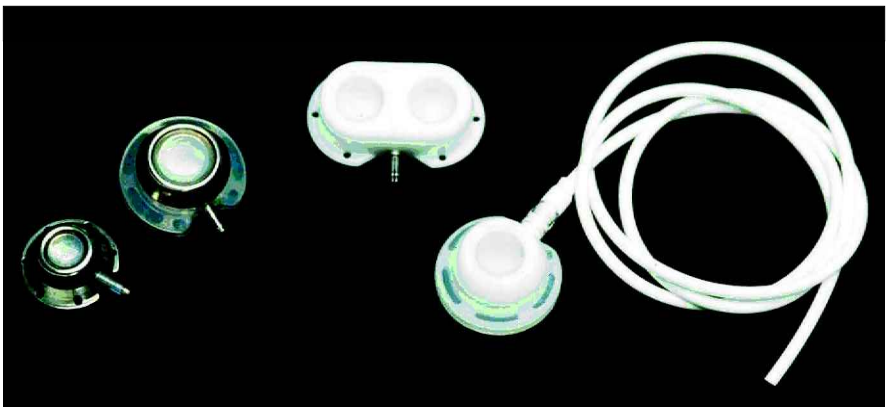

Fig 3. Different types of implantable portacaths used for intravenous feeding. They are placed subcutaneously. In general, they have a single chamber but some dual-chamber portacaths are now available (eg the third from the left).

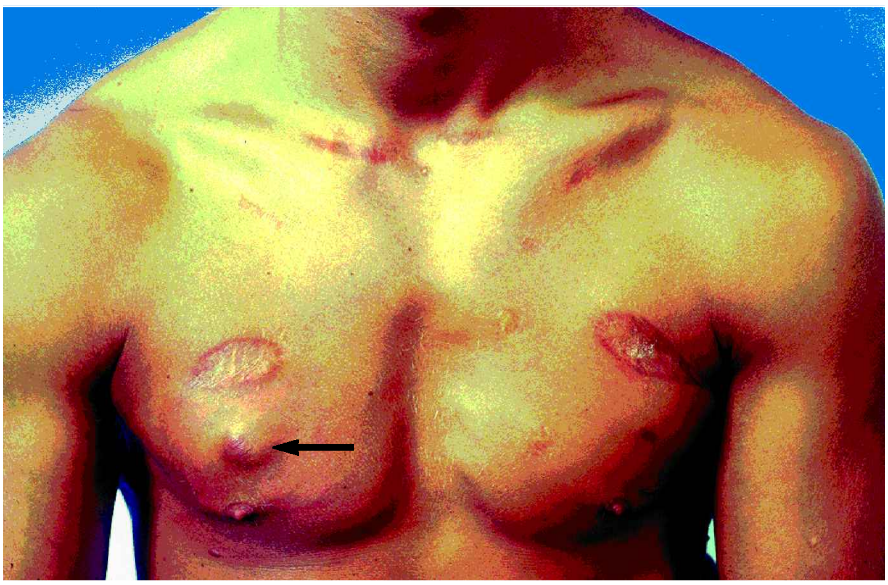

Fig 4. Patient with implanted portacath (arrow), showing scarring from two previous portacaths.

Table 7. Standards for parenteral nutrition catheter insertion (modified from the British Association of Parenteral and Enteral Nutrition[16]).

1	There is a training programme for medical and nursing staff in the techniques of central line insertion and management
2	Written guidelines are available for staff and patient/carers about the insertion and subsequent management of feeding catheters
3	The insertion of a feeding catheter is a planned procedure
4	Informed consent is obtained
5	Adequate sedation/analgesia is given for the duration of the procedure
6	Insertion and subsequent care of the line are performed using a strict aseptic technique
7	If the catheter tip is in a large vein, its position is confined by radiology and documented before feeding commences
8	The catheter is fixed securely in place The connections are appropriate in diameter, length and material to prevent accidental damage, removal or contamination
9	The feeding catheter (or one lumen of a multilumen catheter) is dedicated for parenteral feeding

If the patient has good peripheral access, PPN may be administered via a fine bore cannula placed in the largest possible vein away from the joints. Glyceryl trinitrate patches applied distally to the cannula site are used in some centres to reduce the incidence of thrombophlebitis. Some catheters have an antimicrobial incorporated into the material, but this approach to prophylaxis of catheter sepsis remains experimental.

Long-term parenteral feeding

Silicone elastomer catheters are commonly used for long-term feeding where they can have a lifespan of many years.

Implantable venous access devices

Since their introduction in 1982, implantable venous access devices (portacaths) have gained in popularity. They consist of a vascular catheter and a subcutaneous reservoir made of plastic or metal with a silicone septum that can withstand multiple punctures (Fig 3). Patients access the reservoir by inserting a needle through the skin. This has the advantage of being more aesthetically pleasing and less socially restricting, but patients should be carefully selected for a portacath insertion. If a catheter infection develops, this necessitates removal of the device leaving significant scarring (Fig 4).

Complications of parenteral nutrition catheter placement

Complications resulting from placing a central venous catheter (Table 8) for parenteral feeding vary between 0.5% and 5%, and may be minimised by radiological visualisation (ultrasound guidance or digital subtraction venography).

Catheter-related sepsis

One of the most common, serious – sometimes fatal – complications of parenteral nutrition is catheter-related sepsis (CRS). The rate of CRS has decreased in recent years, probably due

Table 8. Central venous catheter insertion complications.

Injury			
Arterial	**Cardiopulmonary**	**Neurological**	**Mechanical complications**
Haematoma	Tracheal puncture	Brachial plexus	Air embolism
Laceration	Haemothorax	Phrenic nerve	Catheter embolism
Aortic dissection	Pneumothorax	Hypoglossal nerve	Guidewire embolism
Arteriovenous fistula	Haemomediastinum	Recurrent laryngeal nerve	Guidewire arrhythmias and perforation

Table 9. General principles to help avoid catheter-related sepsis.

1	Only experienced staff should touch the catheter
2	Single lumen catheters should be used in preference to double or triple lumen catheters
3	There should be only one connection (three way taps should not be used)
4	The catheter should be used only for parenteral nutrition
5	Blood should not be taken from the line unless a line infection is suspected
6	Additions to the feed are made in an aseptic compounding unit and not on the ward

to recognition that all procedures relating to parenteral feeding should be aseptic. Some principles to reduce this complication are listed in Table 9.

Diagnosis of CRS can be difficult as patients often have other sources of sepsis which may account for the symptoms of pyrexia. Patients may experience a rigor shortly after commencing the feed, which may confirm the diagnosis. Many advocate the cessation of feeding and removal of the catheter with subsequent blood cultures. However, it is possible to salvage catheters; this may be especially important in patients on long-term parenteral nutrition where there is limited central access. Blood cultures should be taken from the line and, while awaiting the results, systemic antibiotics (eg vancomycin or gentamicin) administered only if the patient is shocked. Otherwise, treatment is targeted at the organism cultured.

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