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Access methods in nutritional support

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The limiting factor in nutritional support of the vast majority of patients is the attainment and maintenance of safe access, whether it be to the venous system for total parenteral nutrition (TPN) or to the gut for enteral nutrition. Indeed, the mainstay of nutritional support therapy is deciding the appropriate route for nutritional support and obtaining access to provide that support. Central to this decision is the concept of 'intestinal failure' which was defined by Fleming & Remington (1981) as 'a functioning gut mass below the minimum necessary for the adequate digestion and absorption of nutrients'. Intestinal failure is the only absolute indication for TPN and should not be confused with difficulties in intestinal access. It is still a common occurrence to find a patient on TPN in whom application of the modern principles of intestinal access would allow enteral feeding.

ACCESS ROUTES FOR ENTERAL NUTRITION

Whilst oral intake of enteral supplements is a vital part of nutritional support, in practical terms, enteral nutrition has become synonymous with tube feeding. Without doubt the most significant advances in enteral feeding in the past two decades have been three relatively recent developments in enteral access techniques:

(1) fine-bore naso-enteral feeding tubes;
(2) needle catheter jejunostomy;
(3) percutaneous endoscopic gastrostomy (and jejunostomy).

FINE-BORE NASO-ENTERAL FEEDING TUBES

There is now little justification for using a standard nasogastric (NG) tube for prolonged NG feeding, although it is reasonable to use an indwelling NG tube in the short term (about 1 week). Current polyurethane fine-bore tubes are markedly superior to standard NG tubes, being much better tolerated by the patient and much less likely to cause gastro-oesophageal reflux or ulceration. The majority of fine-bore tubes have wire stiffening stylets to facilitate insertion.

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Table 1. *General complications of enteral or parenteral access*

Failure to obtain access	
Misplacement of the access device	
Displacement:	Partial, resulting in extravasation
	Total, resulting in loss of access
Tube blockage	
Tube failure	
Infection:	Localized
	Generalized
Common complications of enteral feeding tubes and their solution	
Tube blockage: Reduce incidence by:	
Flushing:	Before and after the administration of medication
	Before and after institution of intermittent feeding
The optimal flushing solutions are:	
	Alcohol (e.g. 20 ml sherry or whisky)
	Carbonated mineral water (e.g. Coca-Cola)
Tube displacement: Especially naso-enteral tubes	
Common complications of central venous catheters	
(A) Insertion	
Failure (approximately 5–10% but generally under-reported)	
Malposition	
Pneumothorax (approximately 5% overall for subclavian lines)	
Arterial stab (usually of no consequence if recognized and pressure applied)	
(B) In-use complications	
Line sepsis: Reduce incidence by:	Experienced inserter
	Dedicated TPN line
	Nursing protocols

Tube position should be checked before feeding is started. In a patient who is alert and orientated this may be possible by: (a) air injection and auscultation over the epigastrium; (b) aspiration of gastric contents and confirmation of acid pH. If a patient has altered consciousness or an impaired gag reflex an X-ray is needed to check the position.

Fine-bore tubes are much easier to pass than standard NG tubes and many patients can be taught to self-intubate at night for supplemental overnight feeding. Some fine-bore tubes can be passed over a guide wire and can be positioned accurately under fluoroscopy or endoscopic control into the stomach, duodenum or upper jejenum. Nasojejunal feeding may be successful in some instances where NG feeding has failed; for example, in ventilated intensive-care patients. However, despite the advantages of these tubes they are still subject to most of the general complications of feeding tubes (Table 1).

There are several different designs of tube and several modifications have been made to the opening and weighting of the tip. The manufacturers' claims for several design modifications have not been substantiated in clinical practice (Payne-James & Silk, 1988). Due to some recent evidence that gastric stasis often prevents enteral feeding, particularly in the post-operative period, double-lumen tubes are now available whereby one lumen is positioned in the stomach for NG decompression and the distal lumen is positioned in the upper jejunum for feeding. Enthusiasts have had some success with these tubes but indications for their use are limited.

NEEDLE-CATHETER JEJUNOSTOMY

Delaney *et al.* (1973) described a technique to obtain access to the jejunum via a catheter inserted at operation into the proximal jejunum. The catheter is tunnelled subserosally for several centimetres (using techniques similar to that for tunnelling a central venous catheter) before entering the lumen. This technique is recommended for patients undergoing major upper gastrointestinal surgery (oesophagectomy, gastrectomy or pancreatic surgery) in which complications such as a leaking anastomosis may occur and then the patient might require prolonged nutritional support. With modern kits the complication rates from the jejunostomy are minimal and the catheter can easily be removed if not required. A more definite indication, and almost inevitably overlooked, is in patients who require relaparotomy for complications where the postoperative course is likely to be complicated and the opportunity to obtain effective long-term enteral access is not considered. Prolonged TPN is required due to a lack of access to a functioning small bowel.

The main complications of these catheters are tube displacement, intraperitoneal leakage and small-bowel perforation. These complications are minimal with modern commercial kits and benefits far outweigh complications when used appropriately. However, it must be remembered that these jejunostomy tubes can only be inserted at laparotomy and, therefore, their use is limited.

PERCUTANEOUS ENDOSCOPIC GASTROSTOMY

Surgical gastrostomy has been one of the main methods of long-term enteral support but the surgical techniques have recently been superseded. Gauderer *et al.* (1980) described the technique of percutaneous endoscopic gastrostomy (PEG) for performing a gastrostomy which did not require a laparotomy. The gastroscope is passed into the stomach under sedation and the patient is placed in the supine position. The stomach is inflated with air and the light of the endoscope is then directed anteriorly to transilluminate the anterior abdominal wall. Once transillumination is achieved, the area is infiltrated with local anaesthetic as far as the lumen of the stomach. A cannula is then passed in through the skin into the inflated stomach and a thread or guidewire is passed through the cannula. The thread is grasped with biopsy forceps or a snare and the gastroscope, biopsy forceps and thread are then retrieved through the mouth. The thread is used to pull the tube into position. All current PEG kits contain detailed instructions which should be studied before commencing the procedure. Several variations of the original technique, including a radiological technique, have been described and recently all have been reviewed in detail (Moran *et al.* 1990). Furthermore, it is possible to pass a tube through the positioned PEG and guide the tube into the upper jejunum, a technique referred to as percutaneous endoscopic jejunostomy. Jejunostomy is indicated for patients who suffer reflux resulting in aspiration pneumonia. Personal experience and review of the literature suggests that this occurs in about 5% of patients with a PEG.

The two main indications for PEG are (a) for patients with neurological disorders of swallowing following acute neurological events (stroke or severe head injury) and for a smaller group suffering from chronic neurological diseases such as multiple sclerosis and motor neurone disease; (b) for patients who require prolonged supplemental feeding, for example, patients with head and neck cancer (to facilitate surgery or radiotherapy) and patients with growth failure or anorexia (e.g. cystic fibrosis and scleroderma).

There are few complications with PEG. A failure rate of 5% has been reported due to an inability to transilluminate the stomach, usually in patients with previous extensive upper gastrointestinal surgery or patients with extreme obesity (Moran *et al.* 1990).

It is often impossible to predict survival of the patient but as a general rule a PEG should be used only if it is anticipated that enteral feeding will be required for at least 3 weeks. Other patients may be treated more satisfactorily with a fine-bore NG tube, but the option of a PEG for even short-term palliation should not be ruled out completely. Recently, there have been reports of the use of skin-level gastrostomies or gastrostomy buttons in patients who require long-term gastrostomy feeding and already have an established gastrostomy tract. They are cosmetically more acceptable but are more difficult to use and require more expensive 'giving sets'. PEG has been the most significant advance in nutritional support and continues to be underused in the hospital and the community.

PARENTERAL ACCESS

Parenteral nutrition, by definition, involves intravenous feeding and, therefore, requires venous access. The historic breakthrough in the successful use of TPN resulted from an appreciation by Dudrick *et al.* (1968) that central venous access was required to infuse hypertonic nutrients. More recently, however, there has been a shift in emphasis away from central access with renewed interest in peripheral vein parenteral nutrition.

PERIPHERAL VENOUS ACCESS

Novel solutions, with a lower osmolality, continue to be developed to allow peripheral TPN which is now feasible for 7–10 d, and for longer in some institutions. However, some patients will be unsuited to any form of peripheral-vein feeding due to the lack of suitable peripheral veins. In patients with suitable veins the main limitation is still the hypertonicity of the solutions, in particular amino acid solutions but also the glucose required to provide a cost-effective energy supply. Recent changes in TPN practice, such as the recognition of lower energy requirements of patients than previously considered necessary, the availability of lipid emulsions and the use of all-in-one mixtures (the 3-litre bag), have facilitated peripheral-vein feeding. Also, there have been several recent reports of techniques to prolong the life of the peripheral vein. In order of clinical significance these are:

(1) the use of very fine paediatric venous catheters made from polyurethane or silicone which are threaded into a peripheral vein; these catheters have been very successful when used by enthusiasts but are not free from the serious complications of TPN infusion, namely thrombophlebitis and infection. It must be stressed that an infusion pump is required to reduce blockage;

(2) the application of glyceryl trinitrate (GTN) patches distal to the infusion site has been shown to prolong significantly peripheral catheter infusion time; side-effects from the GTN occasionally occur;

(3) regular rotation of the site of the infusion every 24–48 h; this again works in practice but is costly in patient comfort, medical and nursing time and in consumables;

(4) the addition of heparin to the infusion at a concentration of 1000 units/l;

(5) the use of local (and systemic) anti-inflammatory agents, including low-dose steroid

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additions to the infusion, has several proponents. Despite the theoretical advantages, the effects in clinical practice have been disappointing to date.

These techniques can be combined with further prolongation of catheter life. However, the main continuing problem with peripheral TPN is that it is inferior to central venous TPN. Unfortunately neither medical nor nursing staff apply the same degree of attention to detail in the care of a peripheral line. The best results are achieved in units with a multidisciplinary nutrition team which gives meticulous attention to protocols for TPN lines. The cannula should be inserted under sterile conditions, by an individual experienced in the technique, and should be cared for using protocols similar to those used in the care of central venous TPN catheters. The peripheral cannula should be used exclusively for TPN and observations should be made for the early signs of thrombophlebitis; the cannula should be removed and replaced as necessary. There is little doubt that peripheral venous cannulation is far safer than central venous cannulation and is likely to provide an increasing proportion of parenteral nutrition.

CENTRAL VENOUS ACCESS

Currently central venous access is the optimal route for prolonged effective TPN. Techniques of insertion themselves have varied little, the main routes being via subclavian and internal jugular veins, by a direct cutdown or, increasingly (even in children), a blind percutaneous technique. An excellent review of the various techniques, and complications thereof, is to be found in the venous access section of a recent textbook (Grant, 1992). It is salutary to note that the cumulative insertion complication rate for 12 987 catheters in fourteen recently reported large surveys is approximately 10%, with failure to cannulate, misplacement, pneumothorax and arterial puncture being the most common.

Controversy continues as to whether percutaneous subclavian or jugular vein cannulation is the safer and better route. My personal preference (which is supported by others) is that the subclavian route under local anaesthetic is better (although the risk of a pneumothorax puncture is higher than that with jugular cannulation). The advantages of the subclavian route are superior patient comfort and infinitely easier catheter tunnelling from a subclavian site. The main most recent advances in central venous access have been newer catheter materials, development of percutaneous catheters which incorporate a dacron cuff and the increasing use of double- and triple-lumen catheters for TPN.

CATHETER MATERIAL

There are only two materials suitable for prolonged central venous access, i.e. silicone and polyurethane. Polyurethane has been reported to be less thrombogenic than silicone. However, the real advantage of polyurethane is its superior strength, which allows construction of catheters with a large lumen:external diameter ratio (thin wall). This facilitates percutaneous insertion and reduces the volume of intravascular foreign material.

CATHETERS INCORPORATING A DACRON CUFF

A significant advance in central venous access for chemotherapy or prolonged TPN was the development and use by Hickman *et al.* (1979) of a catheter which incorporates a dacron cuff (still referred to as the 'Hickman' catheter). There have been several modifications to the design and use of the cuffed silicone catheter, including techniques for percutaneous insertion under local anaesthetic; the family of these catheters is now referred to as the 'Hickman/Broviac' catheters. The dacron cuff is located subcutaneously and becomes incorporated into fibrous tissue which keeps the catheter in place and may reduce catheter infection. The difficulty in attaching a dacron cuff to polyurethane has recently been overcome and the first clinical trial of prolonged use of a cuffed polyurethane catheter has been reported (Moran *et al.* 1992). However, in the vast majority of patients a cuffed catheter is not required and the use of these catheters has generally been reserved for patients on chemotherapy or on home TPN.

MULTI-LUMEN CATHETERS FOR TOTAL PARENTERAL NUTRITION

There is increasing interest in the use of multi-lumen catheters for TPN. Whilst this may be essential in some situations (for example, small children being aggressively treated by cytotoxic chemotherapy) and advantageous in many others, my personal practice has generally been to avoid and discourage use of multi-lumen lines for TPN. Anecdotal evidence suggests that the incidence of infection has been much higher with multi-lumen catheters. Recent cumulative evidence from fifteen publications supports this (Grant, 1992), with a significantly ($P<0{\cdot}0001$) higher incidence of sepsis in triple-lumen lines (8·8% of 1910 triple-lumen lines compared with 3·8% of 1482 single-lumen lines). However, this may be because the patients in whom multi-lumen catheters are used have more active disease and a greater degree of immune suppression.

HOME TPN

The principles of venous access for home TPN are similar to those for short- or medium-term venous access. In general catheters which incorporate a dacron cuff (Hickman/Broviac or the novel cuffed polyurethane catheters) are used and some centres advocate the use of subcutaneous implantable systems, as used for prolonged chemotherapy. Venous access is crucial in these patients and complications of venous access are the leading cause of morbidity and mortality in this group of home TPN patients.

CONCLUSION

All techniques for providing access to the venous system or the gut have complications and some of these complications are fatal. Operator experience minimizes, but never abolishes, the risk. Undoubtedly a multidisciplinary nutritional support team plays a key role in deciding the route of access and in providing and maintaining safe enteral and parenteral access.

REFERENCES

Delaney, H. M., Carnevale, N. J. & Garvey, J. W. (1973). Jejunostomy by a needle catheter technique. *Surgery* **73**, 768–780.

Dudrick, S. J., Wilmore, D. W., Vars, H. A. & Rhoads, J. R. (1968). Long-term total parenteral nutrition with growth, development and positive nitrogen balance. *Surgery* **64**, 134–142.

Fleming, C. R. & Remington, M. (1981). Intestinal failure. In *Nutrition and the Surgical Patient*, pp. 219–235 [G. L. Hill, editor]. Edinburgh: Clinical Surgery International, Churchill Livingstone.
Gauderer, M. W. L., Ponsky, J. L. & Izant, R. J. (1980). Gastrostomy without a laparotomy: a percutaneous endoscopic technique for feeding gastrostomy. *Journal of Pediatric Surgery* **15**, 872–875.
Grant, J. P. (1992). *Handbook of Total Parenteral Nutrition*, 2nd ed. Philadelphia and London: W. B. Saunders.
Hickman, R. O., Buckner, C. D., Clift, R. A., Sanders, J. E., Stewart, P. & Thomas, E. D. (1979). A modified right atrial catheter for access to the venous system in marrow transplant patients. *Surgery in Gynecology and Obstetrics* **148**, 871–875.
Moran, B. J., Sutton, G. L. J. & Karran, S. J. (1992). Clinical evaluation and long-term usage of a new cuffed polyurethane catheter for central venous access. *Annals of Royal College of Surgeons* **74**, 426–429.
Moran, B. J., Taylor, M. B. & Johnson, C. D. (1990). Percutaneous endoscopic gastrostomy: A review. *British Journal of Surgery* **77**, 858–862.
Payne-James, J. & Silk, D. B. A. (1988). Enteral nutrition: background, indications and management. *Ballières Clinical Gastroenterology* **2**, 815–847.

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