Management and effects of parenteral nutrition

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Despite nutrition being a basic human need, malnutrition in hospitals remains surprisingly common, with the effects clearly documented (Taylor and Goodison-McLaren, 1992). Malnourished patients are more likely to suffer from complications; are at increased risk of developing infections; have poor or delayed wound healing, increased mortality rates and longer hospital stays. This article focuses on the basics of parenteral nutrition in the adult, addressing a small selection of potential complications.

Nutrition support teams (NST) evolved to promote nutrition as a positive therapy for hospital patients to reduce the incidence of malnutrition. The multi-disciplinary NST provides specialist services that facilitate the development of protocols, standards, research, education and quality assurance (Hudson, 2000). The British Association for Parenteral and Enteral Nutrition (BAPEN) has published specific guidelines regarding setting up such teams (Silk, 1994).

Unfortunately not every trust has nutrition as a priority, effective leadership is crucial to providing nutritional support. The need for effective communication between all levels of health care professionals is even more crucial (Hudson, 2000).

What is it?
Parenteral nutrition, otherwise known as intravenous nutrition (IVN) is the intravenous infusion of nutrients that are pharmaceutically compounded in a large collapsible bag (Pennington, 2000).

The various terms for parenteral nutrition that have been used within the literature are somewhat confusing. Total parenteral nutrition (TPN) refers to the exclusive administration of all nutritional requirements via the intravenous route. Supplemental parenteral nutrition (SPN) refers to the administration of some element of the required nutritional requirements, with other components being met via enteral absorption. These terms may lead to confusion and, although total parenteral nutrition (TPN) is the most commonly used terminology, parenteral nutrition is preferred.

Why is it given?
Parenteral nutrition is needed when the intestine cannot be used or cannot absorb or digest adequate amounts of nutrients temporarily or permanently. As enteral feeding or using the oral route is cheaper, safer and associated with physiological advantages, parenteral nutrition should only be considered if full requirements are not able to be met by these safer, more natural methods. Even after intestinal surgery when gastric motility may not have fully returned, there is evidence that small bowel function returns earlier and could be utilised in nasojejunal feeding or feeding via a surgically placed jejunostomy to avoid use of parenteral nutrition (Pennington, 2000).

Conditions in which parenteral nutrition is commonly used in adults can be seen in Box 1.

How is it given?
Once the patient’s nutritional requirements are calculated, nutrients, electrolytes, vitamins, trace elements and water can be infused using an infusion pump through a central venous catheter (CVC) or a cannula. Ideally a dedicated single lumen device is desirable as complications of catheter-related sepsis and blockage can be minimised.

However, it is likely that acutely unwell patients will require other infusions and therapies and, in these cases, the use of multi-lumen catheters is essential. If multi-lumen catheters are used, it is important that...
one lumen be dedicated to parenteral nutrition to ensure minimisation of contamination and that an equal level of asepsis be applied to all lumens (Hamilton, 2000). If using a single-lumen device, routine blood sampling and additional infusions should be carried out independently, using a separate cannula if necessary.

In choosing a device, there are many different types of device or cannula to suit the type and duration of therapy and it is important that each patient’s needs are assessed individually. Points for consideration in choosing a device can be seen in Box 2 (p30).

The type of device to be used and the insertion method will usually be determined by the planned duration of therapy and venous access status of the patient. Parenteral nutrition given over a short period such as one or two weeks, can often be successfully administered using a peripheral cannula or by using a peripherally inserted central catheter (PICC) to gain central venous access using a peripheral vein. Due to the potential problems of thrombophlebitis, strict aseptic technique at insertion and all manipulations of the cannula is essential if peripheral parenteral nutrition therapy is to be successful. Once enteral intake is established, or if there are problems such as thrombophlebitis causing pain and inflammation of the peripheral vein, the cannula can be promptly and easily removed and the patient’s needs reassessed.

For longer-term parenteral nutrition therapy, a central venous catheter is inserted into one of the central veins – typically the subclavian and jugular veins or, if gaining venous access is a problem due to previous central venous catheterisations, venous thrombosis or damage making future cannulation of the same vein impossible, the femoral veins can be used (Hamilton, 2000).

If it is felt that a patient will need parenteral nutrition for the foreseeable future, such as in complex intestinal failure, a structured approach is essential in order to plan which veins are to be cannulated and in which order. This will promote the preservation of veins over the longer term in the hope of maintaining lifelong venous access.

The most appropriate site for patients requiring long-term parenteral nutrition is the subclavian vein, with the catheter subcutaneously tunnelled onto the chest wall so the catheter exits the patient at a point away from the bloodstream to reduce the incidence of bloodstream infection. Siting the catheter in this way can provide the patient a clear view of both the device and exit site, making aseptic manipulations easier and helping build patient confidence. Box 3 (p31) provides an overview of the types of device.

The insertion of a central venous device should only be undertaken by an operator experienced in gaining central venous access. It should be carried out in an environment with an appropriate level of cleanliness and facilities for screening to aid insertion and confirm catheter tip position as being low in the superior vena cava or right atrium, once the device is in place.

In centres where there is an established multidisciplinary support team providing a parenteral nutrition service, it is likely that there will be an identified experienced operator or team of operators adopting a standard insertion method and using standardised equipment as defined with a multidisciplinary care protocol.

Following insertion, it is important that the patient’s vital signs are monitored to detect any complications related to central venous catheterisation, including pneumothorax, arterial puncture, air embolism, cardiac tamponade, infection, catheter misplacement and neurological damage (Drewett, 2000). The frequency and duration of monitoring will depend on the condition of the patient and local policy.

Parenteral nutrition will usually be prescribed to run continuously over a 24-hour period initially. Again, it is important that vital signs, fluid balance, blood glucose, weight and blood biochemistry be closely monitored with feed volume and/or components adjusted accordingly. If blood glucose levels remain below 10mmol/L after the initial 24-48 hours, daily urinalysis should be sufficient.

Providing the patient remains physiologically stable on the regimen, the rate of infusion can gradually be increased each day to allow ‘free time’ from the infusion and all its paraphernalia. For those requiring longer periods of time attached to their infusion, such as in complex intestinal failure where the infusion volume can reach several litres in a 24-hour period, an ambulatory pump can be used. This offers the patient increased mobility while attached to the infusion. It is important to note that, although this level of monitoring is essential in the acutely ill patient, it should not be necessary in the long-term, physiologically stable, home parenteral nutrition patient.

REFERENCES


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Potential complications
Catheter-related sepsis is the most common type of complication associated with central venous devices and parenteral nutrition administration and should be a patient care priority for any health care professional. A definition of catheter-related sepsis is a ‘clinical picture of spiking fever and chills resulting from blood passage of micro-organisms from an intravascular infusion system. Isolation of the same organism from blood and catheter segments is considered definite proof’ (Sitges-Serra et al, 1985).

Typical clinical symptoms can include pyrexia greater than 38°C and rigors that begin soon after the infusion starts and subside when the infusion is stopped. It is important to remember, however, that this is the most common presentation of a catheter-related infection. Many patients do present differently, for example with lower-grade pyrexia, feeling generally unwell and pyrexia when the patient is not being infused, and need to be individually assessed.

Infections can be external to the catheter initially such as in an exit site infection (erythema, tenderness, induration or purulence within 2cm of the skin at the exit site of the catheter) or tunnel infection (erythema, tenderness and induration in the tissues overlying the catheter and greater than 2cm from the exit site) (Scottish HPN Group, 2002). If left untreated, micro-organisms can track along the catheter or can seed the catheter from cross-contamination.

The optimal dressing for the exit site remains controversial. The dressings commonly used are sterile gauze dressings and transparent occlusive dressings. Some studies have reported an increased rate of infection associated with the use of transparent dressings. It is thought that this could be due to an increase of moisture at the exit site (Hoffman et al, 1992; Dickerson, 1989), although other studies have found this not to be the case, showing no statistical difference in rates of infection between transparent or gauze dressings (Little and Palmer, 1998; Madeo et al, 1997). It has been suggested that transparent occlusive dressings are preferred by the patient, are cost-effective and can result in a reduction in nursing time required (Shivnan et al, 1991).

The catheter infection rate within the clinical area is influenced largely by the level of education and training of health care professionals and patients. Research evaluating products and procedures has, unfortunately, been relatively small and inconclusive, which has led to much confusion and vast variation in practice (Sheriker, 2000). Health care professionals should, therefore, analyse the available data to develop care protocols that give guidance on all aspects of catheter care from handwashing to managing catheter-related sepsis.

Device patency is essential in the management of the patient receiving parenteral nutrition, and flushing the device is vital in the prevention of complications such as catheter occlusion. There are many factors that may lead to occlusion of the catheter (Scottish HPN Group, 2002), including:
- Poor positioning of the catheter;
- A kink in the catheter;
- The formation of a fibrin sheath at the tip of the catheter can act as a one-way valve, allowing saline to be flushed but preventing the withdrawal of blood;
- Fibrin deposits caused by the formation of a clot due to stagnant blood left in the catheter lumen;
- Lipid sludge caused by lipid deposit formation;
- Drug precipitation.

There remains much debate as to what the catheter should be routinely flushed with to maintain patency. A survey by Cottee (1995) was carried out to determine the current practice for maintaining catheter patency in the UK. Although the majority used heparin solution, concentrations varied from 1 unit per ml to 5000 units per ml, and the volumes used varied from 1ml to 5ml. While it is considered that the use of heparin is harmless, complications such as drug interactions, thrombocytopenia and thrombosis syndrome have been reported with the use of heparin flushes, and several studies have indicated

Guided reflection
Use the following points to write a reflection for your PREP portfolio:
- Explain how this article is relevant to a patient in your clinical area;
- Highlight the key points the article makes;
- Outline something new you have learnt about parenteral nutrition;
- Consider how you could use this information in the care of a patient;
- Outline how you will follow up what you have learnt.
that there is no significant difference between flushing peripheral catheters with sodium chloride or heparin (Kyle and Turner, 1999; Randolf et al, 1998; LeDuc, 1997; Hamilton et al, 1988). Catheters should, however, be flushed using syringes no smaller than 10ml because they exert greater pressure, which in a partially occluded device could rupture the material. Fibrin deposition within the lumen of the catheter can be cleared with the administration of urokinase. Drug precipitation and lipid deposition can be treated with ethanol or hydrochloric acid. Again, there is no clear evidence-based guidance on dosage, concentrations or dwell times, and more research is needed so that patency can be more effectively maintained and problems dealt with promptly using the correct treatments (Scottish HPN Group, 2002).

Parenteral nutrition is a safe, effective and life-saving therapy if monitored and managed appropriately with a multidisciplinary approach. It is clear, however, that despite over three decades of use, substantial gaps in the evidence base still exist. The development of evidence-based multidisciplinary care protocols that cover every aspect of parenteral nutrition administration, preparation of the patient, examination, monitoring and long-term management of the central venous device are essential in minimising the risk of complications (Hamilton, 2000). BAPEN has publications relating to many different aspects of artificial nutrition support administration that can be referred to (Pennington, 1999). In Scotland, a network of hospitals has successfully standardised care through the development of a managed clinical network. In England, work is being carried out between the two national centres of excellence for intestinal failure (St Mark’s Hospital, London and Hope Hospital, Salford) and the National Nurses Nutrition Group (NNNG) in the development of national guidelines for parenteral nutrition.

### BOX 3. DEVICES SUITABLE FOR PARENTERAL NUTRITION ADMINISTRATION

<table>
<thead>
<tr>
<th>PERIPHERALLY INSERTED</th>
<th>These can be manufactured from PVC or silicone rubber, covering a variety of lengths and gauges.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHORT TERM</td>
<td>These may be manufactured from rigid material, such as Teflon, and are intended to remain in position for several days only, or from softer polyurethane, which may remain in place for several weeks. They are most commonly used during major surgery or cardiopulmonary resuscitation.</td>
</tr>
<tr>
<td>LONG TERM</td>
<td>These are generally manufactured from polyurethane or silicone rubber. The smooth material reduces the risk of abrasion to the veins and such catheters can be left in position for much longer periods. Silicone rubber and polyurethane catheters are available in various forms to meet clinical need.</td>
</tr>
<tr>
<td>SINGLE LUMEN</td>
<td>This is the most commonly used long-term central venous catheter. Some require external sutures to anchor them in position. Others incorporate a small cuff, which is positioned just beneath the skin. Epithelialisation anchors the catheter to the subcutaneous tissue within 14–21 days, when the external sutures may be removed.</td>
</tr>
<tr>
<td>MULTI-LUMEN</td>
<td>Double, triple or quadruple lumen catheters are available to facilitate the concurrent administration of fluids, drugs, blood and the recording of central venous pressure. The individual lumens are separated for the full length of the catheter.</td>
</tr>
<tr>
<td>TOTALLY IMPLANTED PORTS</td>
<td>These are used for prolonged venous access, particularly when only intermittent therapy is required. In place of an external segment, the catheter ends in a lightweight titanium or epoxy resin port incorporating a thick silicone disk, which lies just beneath the skin. Access to the venous system is achieved by inserting a non-coring needle through the skin and disk into the port.</td>
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### REFERENCES


