Nutritional Support outside the Hospital: Home Parenteral Nutrition (HPN) in Adult Patient

Module 19.3

Venous Access for Home Parenteral Nutrition

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Learning Objectives

- Learn about different central venous access devices (CVAD);
- Catheter related complications of infectious and mechanical origin;
- Strategy to prevent problems and treatment of complications.

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Key Messages

- Chose access for central venous access device in accordance with the need of the patient;
- General use of aseptic techniques are of paramount importance;
- Support patients educationally to minimise line related complications;
- In case of complications use protocols to treat patients;
- Support clinical studies of venous access for HPN patients.
1. Introduction

Parenteral nutrition is required when patients are unable to maintain an adequate nutritional status, fluid or electrolyte balance due to insufficient function of the gastrointestinal tract. The most common causes of intestinal failure are resection of the small bowel due to a catastrophic event such as mesenteric thrombosis, small intestinal disorders that cause malabsorption and conditions with pseudo-obstruction as well as malignant disease with ensuing intestinal complications or a general need for nutritional support.

Home parenteral nutrition (HPN) is an option for patients with chronic intestinal failure, a condition with a prevalence in the range 1-20 / 10^6 in the European countries (1, 2, 3). For the patient with benign disease, the prognosis of chronic intestinal failure is fairly good with a 5 year survival about 75%; in contrast the prognosis of patients with malignant disease is poor (3, 4). Considering that the number of patients is low the aim should ideally be management in specialist centres, but this may not always be possible.

2. Choice of central venous access

HPN requires a well functioning central venous line. When considering which is the best type of central venous device a number of issues must be taken into consideration; these include the number of weekly infusions, for how long the therapy is going to continue (temporarily or life long), the diagnosis of the underlying disease (benign or not), any previous history in relation to obtaining central venous access and the available expertise.

In relation to quality of life, the age and hence the daily activities of the patient should be taken into account as well as the patients own wishes regarding type of catheter.

Considerations when selecting a venous access device (VAD)

- The number of infusions to be given
- Type and length of therapy
- Available resources and expertise
- The age and diagnosis
- Specific vascular problems
- The VAD history
- Patients preference if long term treatment

Fig. 1

3. PICC lines – an option for HPN?

For short-term treatment, mostly for in-patients, a peripherally inserted central catheter (PICC) can be used for intravenous nutrition. PICC lines have limitations; insertion may be difficult since many patients with a need of parenteral therapy will have damaged peripheral veins and short bowel patients may need infusion of a high volume of parenteral nutrition with a high osmolality thus exceeding the capacity of the line.

Peripherally inserted central catheter (PICC)

- Inserted in the cubital or upper arm region
- Intravenous nutrition and other infusion therapies
- No risk of trauma to neck structures, low risk of thrombosis
- For short term (3-4 weeks) use only
- Mostly for in patients

Fig. 2

Horattas MC et al. 2004; 10:2419-22
Lower rates of infections have been reported with PICC lines and the cost is definitely lower, compared to conventional central lines or ports (5, 6). Altogether, based on the available evidence, PICC cannot be recommended for HPN.

4. Tunnelled catheters

Catherisation of the superior vena cava with a tunnelled silicone rubber catheter has been the most commonly used for long-term parenteral nutrition for more than 25 years. The types used in most centres are Hickman or Broviac catheters. The catheter has a felt cuff and fixation is achieved as the subcutaneous tissue adheres to the cuff, which is placed in the subcutaneous tunnel about 1 inch from the exit site. The tip of the catheter should be located in the caval vein or right atrium. Multi-lumen catheters are available, but cannot be recommended, as an increased number of access points theoretically will increase the risk of infection. In a single study however no increase in infection rate was reported with multi-lumen catheters supporting that if strict infection control measures are used the increase in risk is not clinical significant (7).

Broviac or Hickman catheter

- Commonly used for HPN
- Different types with more lumens
- Blood draws should be avoided (infection)
- Covered by transparent dressing
- Patient may need help for dressing change
- Body image
- Shower and bathing possible

Groshong® catheters have a rounded tip with a pressure sensitive two-way valve at the intravascular end. The valve is closed when the catheter is not used and opens outwards during fluid infusion or bolus injection. The valve can open inwards if blood is drawn and is closed after the procedure. The risk of catheter occlusion and air embolism is reduced, and heparin can be replaced by saline to flush the catheter between infusions since blood reflux is avoided. Long-term experience with this type of catheter has not been published.
The advantages of tunnelled catheters in general are that they may remain in place for many years and connecting does not require puncture of the skin as with implantable ports. If the external part of the catheter is damaged, it can be replaced using a repair kit. In case of infection it is not always required to remove the catheter; antibiotic treatment may salvage catheters in about 30% of cases with line infection (3).

The disadvantage relates to the change in body image because of the external part and the transparent dressing that many centres advocate the use of to cover the exit site.

5. Implantable ports

Another option is totally implantable ports for administration of parenteral nutrition.

A stainless steel chamber with a membrane is implanted in a subcutaneous pocket in the chest wall and the catheter part is placed in the subclavian vein with the tip in the superior caval vein or right atrium. The advantage is that the skin covers the port, which is practically invisible, no dressing is needed and the body image is unchanged.

Among the disadvantages is the need for perforating skin for infusions; compared to catheters with an external segment the port generally requires more frequent replacement. When infected, antibiotic treatment will very rarely salvage the port, which has to be removed surgically (8).
6. Conclusions: which type of venous access for HPN

- PICC are generally not recommended;
- Broviac or Hickman are durable and the most commonly used tunneled catheters;
- Implantable ports can be used, advantages regarding the body image;
- Avoid multi-lumen catheters for HPN due to increased risk of infection.

7. Choice of central vein

There are no data on this subject for catheters for long-term use. Studies mainly in the intensive care setting have shown that subclavian puncture is associated with a lower frequency of catheter related infections compared to jugular insertion (9). A further advantage of subclavian cannulation is that the exit site of the tunneled catheter can be placed readily available allowing the patient self-management of parenteral nutrition and this is obviously important for patients on HPN.

Complications in relation to insertion, among which are arterial puncture and damage to neck structures, can be reduced using imaging techniques such as ultrasound for jugular insertion, but this does not apply to the preferred subclavian site (10).

In case of previous complications and suspicion of thrombosis venography can provide essential information to guide insertion at the subclavian site. Generally, femoral vein catheterisation should be avoided due to a much higher risk of mechanical complications and thrombosis, which is about 10 times the rate for subclavian access (9).

8. Position of the distal tip of the catheter

Position of the distal tip of the central venous catheter is important for increasing longevity and minimizing adverse events in patients on HPN. Thus after insertion it recommended to verify the position of the tip using x-ray or fluoroscopy.

In a retrospective study of 141 central venous lines catheter tip location was the only factor that was statistically predictive of malfunctions (11). A significant increase in malfunctions was observed in cases where the catheter tip was located more than 4 cm superior to the junction of the right atrium and the superior caval vein. Malfunctions were minimized in those cases where the catheter tip was located in the right atrium.
9. Loss of vascular access

Patients maintained on HPN for many years may encounter repeated line complications with thrombosis and loss of vascular access may eventually be the result. Case reports of access by direct puncture of the right atrium or by cannulation of the hepatic veins have been reported (12). The use of an external arterio-venous graft for intravenous nutritional support may also be an unconventional option (13). It is important to consider the possibility of intestinal transplantation and this should be done at the latest when one vascular access route remains open since this is required for the nutritional and intensive care support if a transplant is performed.

10. Conclusions: catheter insertion and position

- Sterile conditions when inserting catheters to reduce infectious complications;
- Lower rate of complication at subclavian < jugular < femoral veins;
- Ultrasound my help to guide when inserting at jugular veins;
- Avoid using femoral veins due to high risk of complications;
- Catheter tip at junction of caval vein and atrium results in fewer malfunctions;
- If only a single venous access is left consider referring for intestinal transplant.

11. Catheter related bloodstream infection or sepsis, risk factors.

Catheter related sepsis remains one of the most frequent complications in this group of patients and requires that patients be admitted to hospital for treatment. The ESPEN-HAN group performed a survey reporting the experience of 12 centres, a total 447 patients and an impressive total number of catheter days of 110,869. Complications occurred in about 25% of patients and in about half the cases it was an infection and this required removal of the catheter in about 12% of patients.

Implantable ports and a daily need for nutrition could be identified as risk factors. Interestingly, the use of catheters for other than nutritional purposes reduced the risk of infection, probably reflecting that thorough care of the line as well as careful administration of parenteral nutrition is very important (14). In a study from this center (3) the presence of a stoma and high age were associated with a higher risk of catheter related bloodstream infection.

12. Prevention of infection dressing

Generally patients to cover the exit site of the catheter use a transparent dressing. This prevents friction with clothing, which may present a problem. About 25 controlled and uncontrolled studies have been carried out testing different types of dressings and in a review 15 studies were included in a meta-analysis (15). The conclusion was that no specific type of dressing or gauze is superior regarding the prophylactic effect on infections, but studies are hampered by inclusion of small number of patients.
13. Antimicrobial impregnated catheters.

May lower risk of infection, but the effect is relatively short and this approach is not at this stage relevant for the HPN patients in whom the number of catheter day generally exceeds months (16).


Educational intervention generally reduces complications if patients use the information they have been taught, and in particular if the education is interactive. This has also been applied in HPN patients in a randomized controlled trial to test interactive video based intervention. Patients in the active group had a significantly lower frequency of line infection at 6 and 18 months (and of admissions for this) (17). Patients in the active group also proved better at defined problem solving, had less depression, and scored better on quality of life measures.

Many centres will use some kind of instruction, handout material, and hands on exercises and in some case video based programs or other teaching methods, but very few have been validated.

15. Treatment of catheter related blood stream infection.

If a line infection is suspected initiation of antibiotic treatment is the response of the clinician. Longevity of lines should be as high as possible since repeated insertion of new line carries a risk of complications and loss of vascular access.
It may not always be easy for the clinician to distinguish between colonization of the catheter and blood stream infection. In a study to investigate the difference in bacteriology between colonized catheters and blood stream infection in 354 HPN patients 249 catheter tips of a total of 600 catheters were cultured.
Sixty tips were culture positive. There were significant differences between microbiology of those who were judged to have catheter related sepsis and those who only had a colonized catheter. The presence of fungi indicated true catheter infection, in contrast to the finding of Gram positive cultures, which rather indicated colonization (18).

This confirms the clinical experience from our centre that if patients present with fungal infections it is always required to remove the line, in case of bacterial infection the line can generally be saved in about 30% of cases with blood stream infection.

**Catheter associated infection**

- Colonisation
  - The presence of organisms in the catheter by culture
- Blood stream infection
  - Culture of the same organism in the catheter and blood stream and no other source of infection
- Exit site infection
  - Erythema and tenderness or purulence within 2 cm of the exit site

**Suspected catheter related infection**

- Blood cultures drawn from catheter and a peripheral site
- Culture from the hub
- Inspect catheter site for signs of infection – if erythema or pus consider removal
- Antibiotic treatment

Fig. 14

16. Repeated line infection

If patients on long term HPN encounter repeated line infections, intervention apart from changing the line may be appropriate. Re-education in all necessary procedures should be carried out in all patients with line sepsis. Other measures that have been applied are the use of line lock with antibiotics, urokinase to lyse a thrombus and possibly alcohol to dissolve debris (19), but no controlled studies of this are available. In a recent study, Jurewitsch et al (20) applied daily antimicrobial chemotherapeutic treatment with taurolidine, an antibiotic, as a catheter lock in seven HPN patients. The pre-treatment infection rate of 10.8 line infections pr 1000 catheter days dropped to 0.8. More studies are warranted.

**Catheter related infection**

- Antibiotic treatment according to microbiology
- *Catheter lock ?
  - Antibiotics to disinfect
  - Alcohol to dissolve organic debris
  - Urokinase to lyse fresh thrombus
- Save catheter when possible
- Remove immediately in case of septic shock

Fig. 15

*Case reports and small studies in support
Catheter related venous thrombosis

- In 33% of ICU patients by Doppler
- Risk higher with insertion at femoral > jugular > subclavian site
- If diagnosed in the HPN patient population
  - Removal of catheter, anticoagulant treatment
  - Thrombolytic medication?
  - Loss of venous access
  - Probably under diagnosed
  - Clinical studies warranted

Fig. 16

17. Catheter related thrombosis

Generally the catheter should be removed and anticoagulant treatment should be initiated. The prevalence of this complication is probably underdiagnosed. The consequence is usually loss of venous access. In this and other centres this complication occurred at 0.05 episodes every catheter year (3, 4). Complications may arise, as embolus is a risk.

18. Conclusions: Catheter related infection and thrombosis

- General barrier precautions and education of patients is of paramount importance;
- Save lines for HPN on average possible in about 25% of cases with infection;
- Infections with fungi requires line shift;
- Repeated line infections may be reduced by antibiotic lock (case reports);
- Thrombosis related to catheter is a relatively rare complication.

References