Long-term central venous access device selection

It is important to take account of individual preferences and situations when assessing patients for a central venous access device.

In this article...

- Types of long-term central venous access devices
- Overview of the circulation system
- Considerations when assessing patients for a long-term CVAD

Due to an increasing range of intravenous (IV) therapies, the number of patients requiring vascular access for sustained periods of time is increasing (Department of Health, 2011; Dougherty, 2008).

Historically, these therapies have been administered within secondary care. However, a change in the focus of healthcare services is leading to more care being delivered in patients’ own homes or in the community. As a result an increasing number of patients are receiving or self-administering IV therapies away from secondary care (Braine and Woodall, 2012; DH, 2011).

Through detailed assessment, which should include discussion with the individual patient, the most appropriate central venous access device (CVAD) can be chosen that meets clinical requirements and individual preferences (Gabriel, 2008a). Time spent undertaking the assessment and choosing the correct device will reduce the potential for complications resulting from the CVAD itself or the intended IV therapy (Gabriel, 2008a; 2008b).

The circulation system: an overview

Every cell in the body requires an adequate flow of blood to deliver nutrients and remove waste products. This is achieved through the circulation system, which is composed of the following vessels (Scales, 2008):

- Arteries;
- Veins;
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- Capillaries.

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Blood leaves the heart through the ascending aorta and flows into three main arteries (Scales, 2008):

- Left common carotid;
- Brachiocephalic trunk;
- Left subclavian artery (Fig 1).

Arterioles allow blood to flow into smaller vessels called capillaries.

Arteries and veins are both constructed from three layers that form a tubular structure. The inner layer of these vessels is called the tunica intima, the middle layer is the tunica media and the outer layer is known as the tunica adventitia (Fig 1). Arterioles allow blood to flow into smaller vessels called capillaries.

FIG 1. THE ARTERIAL SYSTEM

Common carotid arteries
Brachiocephalic artery
Right axillary artery
Right brachial artery
Subclavian artery
Arch of aorta
Thoracic aorta
Abdominal aorta

Construction materials
CVADs are constructed from polyurethanes or silicone rubber. Those constructed from polyurethane tend to be more rigid and less flexible than those made from silicone rubber, but have the advantage of having thinner walls. This means they can have the same overall gauge (thickness size) as devices constructed from silicone rubber, but achieve a larger internal diameter, thereby allowing a higher flow rate (Dougherty, 2006). CVADs constructed from silicone rubber are softer, which minimises the potential for phlebitis (irritation to the tunica intima) (see part 2 of this series, to be published on 9 October, for details) (Dougherty, 2006).

Types of CVAD
There are four types of CVAD, three of which can be used for long-term central venous access.

Skin-tunnelled catheters
Skin-tunnelled catheters are tunnelled under the patient’s skin, usually on the chest wall. The central venous circulation is accessed by the internal or external jugular veins, or subclavian vein (Fig 3). The catheter is initially secured with sutures at the exit site; the portion of the catheter that is tunnelled under the skin has a Dacron cuff around it to encourage the in-growth of tissue. This provides an additional barrier to minimise the potential for infection and also makes the catheter more stable. Once healing has taken place, sutures are no longer needed to secure the catheter. However, a dressing should be placed over the insertion site.

Central venous access devices
CVADs are vascular-access catheters whose tip lies in the central venous circulation system – in either the superior vena cava or the left atrium (Dougherty, 2006) (Fig 3). Other, shorter catheters, whose tips do not extend as far as the central venous system, should not be referred to as CVADs, or used for therapies that need administering into the central venous system (Gabriel, 2008b).

There are several advantages of infusing into the central venous system (Dougherty, 2008; Gabriel 2008b):

- The large internal diameter of the vessel wall minimises the potential for the CVAD to irritate the tunica intima;
- There is a high volume of blood flowing through the vessels that quickly dilutes the infusates, therefore minimising the potential for them to irritate the tunica intima;
- Large-gauge catheters can be inserted, which allow higher or quicker infusion rates;
- CVADs can, with careful management, provide long-term vascular access if clinically required.

For articles on intravenous therapy, go to http://www.nursingtimes.net/ivtherapy
until the wound is healed (Royal College of Nursing, 2010).

Skin-tunnelled CVADs are available with one, two or three lumens.

Implantable injection ports
Implantable injection devices consist of a catheter attached to an implantable injection port. These catheters can be constructed from polyurethane or silicone rubber and have one or two lumens. They are available as a two-part device, where the catheter is attached to the injection port during the insertion process, or as a complete unit with the port connected to the catheter during manufacture. The port is placed peripherally under the skin, for example on the arm, or centrally on the chest wall (Dougherty, 2006).

A small surgical procedure requiring local or, for some patients, a general anaesthetic is necessary to insert the device. An incision is made to create a skin pocket to accommodate the injection port and the device is secured with sutures to the underlying muscle. The catheter is attached to the port if it is not integrally manufactured, then tunnelled under the skin until the desired venous access point is reached (see skin-tunnelled catheters above). The skin overlying the skin pocket is then closed with sutures and a dressing applied to the wound until healing has taken place (RCN, 2010).

Peripherally inserted central catheters
Peripherally inserted central catheters (PICCs) are a group of single, dual or triple lumen CVADs. They are available in silicone rubber or polyurethane.

Unlike the previous two types of CVAD, PICCs access the central venous circulation through a peripheral placement. The insertion procedure involves cannulation of a peripheral vein, usually the cephalic, basilic or median cubital vein, and the catheter is advanced through the cannula until the tip of the PICC reaches the lower third of the superior vena cava or right atrium. Once the PICC is in position, the cannula is removed, the device is secured to the patient’s skin and a dressing applied (RCN, 2010; Gabriel, 2008b).

Verification of tip location
Before use, all CVADs must have their tip location verified to ensure it is in the central circulation (RCN, 2010; Dougherty, 2006). If the device was not placed in a radiology department and the tip location recorded at the time, a chest X-ray should be performed and the tip location documented. Tip location must be confirmed before any infusates are administered to reduce the potential for complications (see part 2).

Valved CVADs
Skin-tunnelled catheters and PICCs are available as open-ended or valved devices (RCN, 2010; Dougherty, 2006).

A valved catheter can incorporate a three-way valve proximally or distally. If there is no negative or positive pressure, the valve will remain closed, thereby minimising the potential for backflow (reflux) of blood into the catheter or for air to enter the venous circulation system (Gabriel, 2008a). Negative pressure is obtained when a syringe is attached to the catheter and the plunger pulled outward, for example when taking a blood sample. Positive pressure is created when the plunger is depressed into the syringe, for example when using 0.9% sodium chloride flushes (Gabriel, 2008a).

Having a valve incorporated into the CVAD also means that the catheter does not need to be clamped when IV administration sets are changed, as the valve will remain closed.

Range of long-term IV therapies
IV therapies date back to the early 17th century when William Harvey first described the circulation system (Burnham, 2008). His discovery led scientists to consider the possibility of administering medicines directly into patients’ veins.

The early vascular access devices were very crude, consisting of a goosel neck to cannulate the vein and a pig’s bladder to hold the infusates. In the early 20th century, facilitated by the First World War, the central venous access route was first used for hydrating injured soldiers (Burnham, 2008).

Today, a range of peripheral and central venous access devices is available to meet the clinical needs of individual patients, whether they need a short-term infusion or prolonged IV therapy, which for some people can be for many years (Gabriel, 2008a).

The range of therapies that need to be administered intravenously is increasing; these are listed in Box 1, while the range of conditions requiring these therapies are listed in Box 2.

While peripheral vascular-access devices (cannulae and midline catheters) can meet the needs of many patients who require IV therapies, they are unsuitable for those who need long-term venous access because they carry an increased risk of device dislodgement, device breakage and patient discomfort (Gabriel, 2010).

They are also unsuitable for patients who need vesicant medicines/infusates, and highly viscous and non-pH neutral medicines/infusates. These can be highly irritant to the vein, causing chemical phlebitis, and have a potentially high risk of infiltration or extravasation if they leak out of a peripheral vein into the surrounding tissues (see part 2) (Gabriel, 2008b).

Patient assessment
Many patients requiring long-term central venous access will be living with the device for months or even years. The majority of these patients will be away from the secondary care setting and caring for the device themselves or with the support of a carer in their own home. The device therefore has to be suitable for patients’ individual needs. Clinical considerations as

BOX 1. THERAPIES ADMINISTERED INTRAVENOUSLY

- Blood products
- Total parenteral nutrition
- Antibiotics
- Anti-viral agents
- Cytotoxic drugs
- Fluids
- Vitamins
- Antiemetics
- Sedatives
- Analgesia
- Medicines that are not absorbed by other routes

Date when scientists first considered parenteral therapies to be possible: 17th century
A range of factors must be considered when assessing a patient for long-term central venous access are (RCN, 2010; Dougherty, 2006):

- The type of infusate or medicine prescribed;
- Intended length of therapy;
- The type(s) of CVADs that will meet the patient’s clinical needs;
- The amount and type of support the patient has at home;
- Whether the patient is left or right handed;
- Whether the patient has had any negative CVAD experiences and, if so, what;
- The age of the patient;
- Relevant medical history;
- MRSA screening result;
- Whether the patient has had any injuries that could influence the choice of CVAD or its placement, for example a fractured clavicle, or if the patient has a cardiac pacemaker (see part 2);
- Whether the patient has ready access to the additional equipment required to access and manage the device;
- Any questions or concerns the patient may have.

Details of the assessment should be recorded in the notes, together with the information the patient has been given, which should include how to contact out-of-hours support (RCN, 2010). Appropriate management, prompt recognition of potential problems and swift action when needed will increase the likelihood of patients completing their prescribed course of treatment and feeling confident in living with their CVAD.

**Patient and staff education**

The success of any device depends on both staff and patients having good knowledge of its use, including its limitations, and confidence in handling it and dealing with common problems. If we expect patients and carers to assume responsibility for all or part of a prescribed IV therapy, they must have the knowledge and skills to be confident to do so. They should also have clear information on who to contact for support. Information needs to be consistent and accurate so patients feel reassured and are less likely to mismanage their device.

Patient information can take many forms, including:

- Teaching using manikins and “practice” vascular-access equipment;
- Group teaching;
- Videos;
- Written information.

**References**