Venous access

A practical review for 2009

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Venous access is one of the most basic yet critical components of patient care both in hospital and in ambulatory patient settings. Safe and reliable venous access is an important issue in daily practice, and understanding the options and being able to counsel patients on appropriate devices is of growing importance to family physicians.

There are a variety of options available for venous access. Venous access device (VAD) selection must be tailored to each patient's needs and to the type, duration, and frequency of infusion (**Table 1**). In this brief review, we will explore issues related to VAD selection and maintenance.

Conventional peripheral intravenous lines

Conventional peripheral intravenous (IV) lines are simple, inexpensive, and can be used for short-term IV therapy. Veins are typically accessed in the patient's hand or arm, and sometimes in the foot.[1,2] Intravenous lines must be replaced frequently, as the complication rates of infiltration and phlebitis increase dramatically with increased catheter dwell-time.[3] In order to reduce the possibility of phlebitis, the Centers for Disease Control and Prevention recommends replacing peripheral venous catheters and rotating the site at least every 72 to 96 hours.[1] This increases the expense for patients who require IV access for more than a few days and makes outpatient treatment more complex.

Midline peripheral catheters

Midline catheters are inserted into the antecubital (or other upper arm) vein. They are typically 20 cm long and their tips do not reach the central veins of the thorax.[4,5] They are used for venous access of between 1 and 4 weeks' duration but are not advised for administration of vesicant or highly irritating drugs that could harm the peripheral veins (eg, chemotherapy).[4-6] Midline catheters are safe and effective but their use is declining in favour of peripherally inserted central catheters (PICCs), which have similar insertion costs but added benefits of central tip location and longer potential dwell-times.[7]

Central catheters

Central lines terminate in the veins within the thorax. Central lines can be classified as either peripherally inserted or centrally inserted central devices. As central venous access is potentially lifesaving, there are no absolute contraindications to performing the procedure[8]; however, knowing which device is most appropriate for each situation might improve patient outcomes.

Aside from emergent placement of central lines, the indications for central catheters include the following:

- administration of IV fluids, medications, or blood products, either in large quantities or over a prolonged period of time;
- administration of medications that are harmful to peripheral veins (eg, chemotherapy);
- long-term access to the central venous system for repeated procedures, such as blood sampling; and
- poor or inaccessible peripheral venous access.[9-11]

Peripherally inserted central catheters. Peripherally inserted central catheters are most commonly inserted via the basilic, brachial, or cephalic veins.[9,10] Insertion is easier and safer than that of centrally inserted catheters in particular, without the attendant risk of pneumothorax and hemothorax.[10] In some centres, skilled nursing teams have been trained to insert PICCs.

Peripherally inserted central catheter lines are indicated in patients requiring several weeks to 6 months of IV therapy. Common indications for PICC lines include parenteral delivery of nutrition, antibiotics, and analgesics, as well as chemotherapy and repeated blood transfusions.

Peripherally inserted central catheters require frequent flushing and dressing changes, and the insertion site should not get wet. Complications include dislodgment, occlusion, mechanical phlebitis, and deep vein thrombosis (DVT). The claim that PICCs have lower rates of infection than centrally inserted catheters has not yet been substantiated in the literature.[12]

Centrally inserted catheters. For central insertion, preferred veins include the internal and external jugular. Although access to the subclavian might be technically easy using bony landmarks in the absence of ultrasound guidance, it is generally not advised to place VADs directly into this vein owing to the relatively high incidence of venous thrombosis and the increased risk of catheter damage or fracture associated with subclavian lines.[13,14]

The 3 main types of centrally inserted catheters are as follows: non-tunneled, skin-tunneled, and implantable ports.

Non-tunneled catheters: Non-tunneled catheters are primarily used for short-term access in the emergency department, operating room, and intensive care unit. These lines are typically meant for rapid resuscitation or pressure monitoring. The lifespan of the catheter is 5 to 7 days, and can provide up to 5 lumens for separate access.[9] These catheters are associated with a higher risk of infection and are inappropriate for patients who require central venous access for longer than 2 weeks.[9,15]

Skin-tunneled catheters: Skin-tunneled catheters, such as Hickman catheters, are appropriate for longer residence and reduce the incidence of infection by increasing the distance between the skin entry site and the venotomy. Although they provide reliable long-term access, their complications include thrombosis, occlusion, and infection.[16] These lines are favoured in patients requiring frequent and long-term venous access, particularly for infusion of blood products.

Implantable ports: The implantable port consists of a catheter attached to a reservoir that is implanted into a surgically created pocket on the chest wall or upper arm. A needle is inserted through the port's septum to access the reservoir. Advantages include less interference with daily activities, less frequent flushing, and reduced risk of infection. Disadvantages include the need for needle insertion, increased discomfort, and the risk of extravasation. These devices are expensive, and are more difficult and time-consuming to insert and remove.[16]

Issues to consider

Image guidance. Ultrasound evaluation of veins is very valuable to ensure patency before venous puncture. Real-time ultrasound guidance has also been shown to reduce complications and improve technical success of central line placement.[17,18] A recent death following misplacement of a central venous catheter has prompted the Ontario Patient Safety Review Committee to recommend that practitioners who insert central catheters use ultrasound guidance.[19]

Renal failure. In order to preserve veins for future hemodialysis access (fistula or graft), it is essential to consult with the interventional radiologist or nephrologist before placing upper extremity or subclavian lines of any type in patients who might eventually require dialysis.

Thrombosis. Thrombosis can occur within the catheter or within the vein. Thrombosis within the catheter might interfere with infusion (flushing) or aspiration through the catheter, or might cause complete occlusion of 1 or more lumen. Low-dose thrombolytic therapy (eg, alteplase dwell) can often restore patency within an hour.[20] Many VADs include an antireflux valve in their designs or include a positive pressure valve in their packaging. Vigilance in following flushing protocols and the use of prophylactic low-dose anticoagulants where appropriate can decrease the incidence of thrombosis, which in turn reduces the infection rate as thrombus can provide a medium for bacterial growth.[16]

Table 1. Types and uses of current prevailing venous access devices

TYPE OF DEVICE	WHEN TO USE	WHEN TO AVOID
Peripheral devices		
• PIV	For short-term access (up to 96 hours)	When access is needed for more than a few days
• Midline catheter	Rarely used because of growing popularity of PICCs	When access is needed for longer than 1 month or when vesicant medications are involved
Central devices		
• PICC	For medium-term access (up to 6 months) and especially for antibiotics, TPN, chemotherapy, transfusions, and frequent blood sampling	When long-term (or permanent) access is required Not recommended for dialysis (or predialysis) patients
• Non-tunneled central catheter	For short-term access when PIV is not suitable, and especially for resuscitation and central venous pressure monitoring	When access is required for more than a few days (use a tunneled catheter instead)
• Tunneled central catheter	For frequent long-term access, and especially for TPN, transfusions, and frequent blood sampling Can be used when PICC line is contraindicated or not possible	When access of shorter duration is required (consider an implantable port if access is to be less frequent)
• Implantable port	For infrequent access on a long-term basis or when lifestyle concerns make one of the other options less appealing	When venous access is regularly required (frequent needle pokes would be uncomfortable for the patient)

PICC—peripherally inserted central catheter, PIV—peripheral intravenous, TPN—total parenteral nutrition.

The presence of a foreign body (ie, a VAD) might serve as a stimulus for venous thrombosis. The actual incidence of VAD-associated thrombosis is unknown—the majority of patients are asymptomatic. Patients presenting with swelling, warmth, and redness of the arm should be referred for upper extremity Doppler venous ultrasound to check for potential DVT.[21] Subclavian vein compression thrombosis is an uncommon complication of using a VAD; patients presenting with symptoms of subclavian vein compression syndrome should be referred for enhanced chest computed tomography or central thoracic venogram.[22] It is important to note that as long as the VAD continues to function and central venous access is required, it should not be removed on account of venous thrombosis.[23] Venous access device–associated venous thrombosis is treated with systemic anticoagulation, in the same way as lower extremity DVT is managed.

Nonthrombotic occlusion of VAD is uncommon, but can occur when incompatible infusions result in precipitation and blockage of the lumen. Algorithms are available to guide attempts to reestablish patency in such occluded catheters, but are beyond the scope of this review.

Infection. One of the most serious complications of VADs is infection, including bacterial endocarditis. Central devices, including PICCs, carry greater risk of infection because they are open to the larger veins of the body. Tunneled catheters have lower infection rates and ports risk even fewer infections.[9,16]

It is essential to differentiate between local insertion site inflammation and true infection. Infections can be divided into entrance-site cellulitis (which usually responds to antibiotic treatment), skin tract or tunnel infection, and catheter-related bacteremia.[24,25] Preventive use of antibiotics has not been shown to reduce the risk of infection.[26] Meticulous sterile technique at the time of catheter insertion, when accessing the central line, and when changing dressings is essential. Antimicrobial-coated or impregnated catheters have also been developed[27,28]; however, these are seldom used in clinical practice.

Conclusion

Reliable venous access is an essential aspect of medical care. There are many options and approaches from which to choose—selecting the appropriate device and knowledge of the detection and management of complications are skills that are essential to family physicians.

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Competing interests
None declared

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