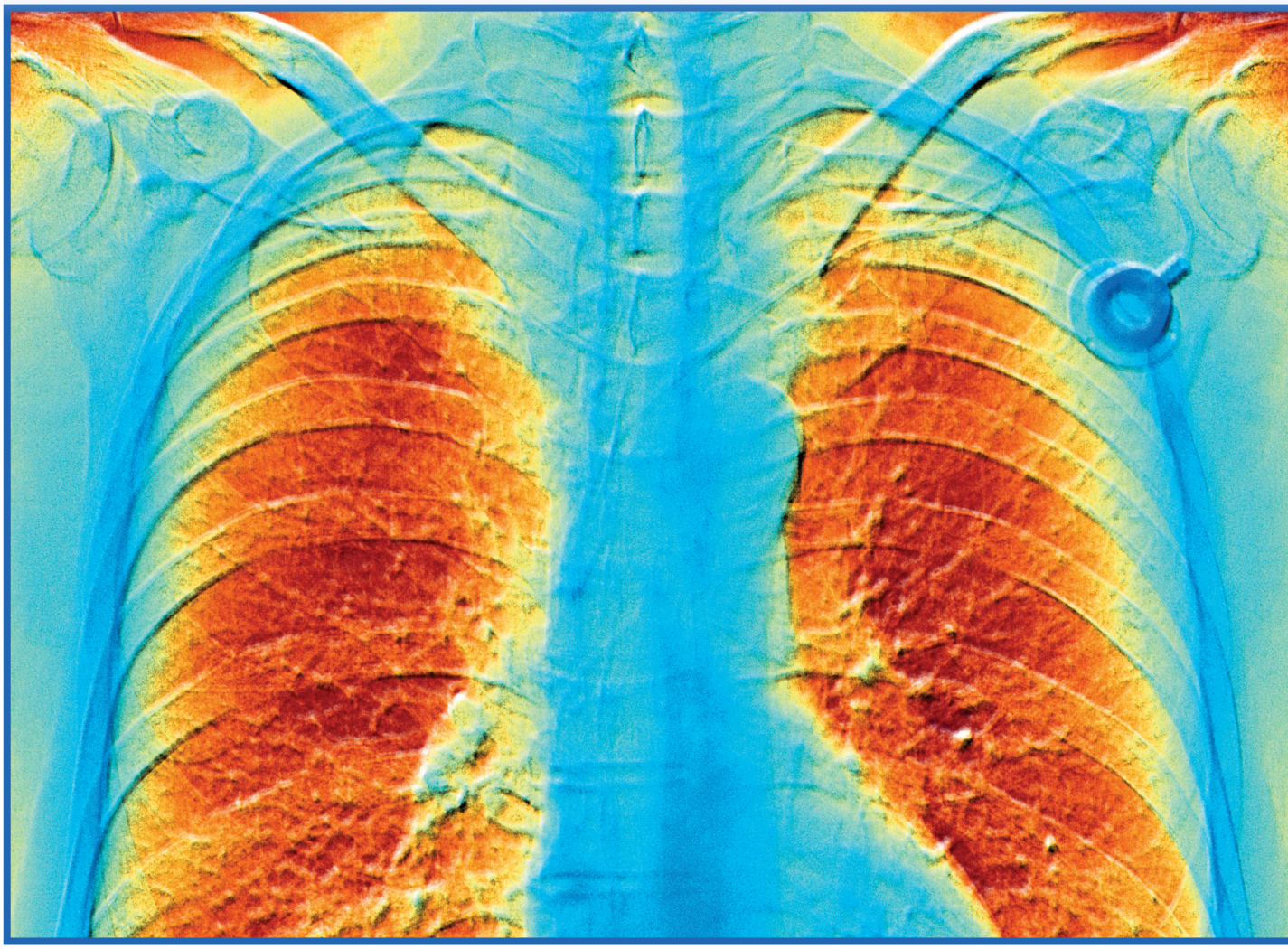
An effective combination for safe long-term intravenous therapy

Implantable ports and non-coring needles



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The case for using implanted ports

Jane Hodson

Uses of central venous access devices (CVADs) include the administration of vital fluids and medications. Implanted ports are a type of CVAD that is used when long-term vascular access is required. The device is discreet and associated with a low risk of catheter-related bloodstream infection. This article describes the different types and components of ports and how to select them. It explains how to insert ports, and provides guidance on accessing and de-accessing them

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Central venous access devices | implanted port | non-coring needle | selection | care and maintenance

Central venous access devices are essential tools for the management of patients short to long term intravenous (IV) therapy. They are inserted for many different reasons, including infusion of fluids, blood products or vasoactive drugs to the central circulation, as well as central venous pressure monitoring, total parenteral nutrition and renal replacement therapy (Gibson and Bodenham, 2013, Anh et al, 2017)

This article provides an overview of the four different types of CVAD, focusing on their use in the upper body, and describes the various types of implanted ports and their indications.

Why use central venous access devices?

The key indications for CVADs are outlined above. Their use might also be considered for patients with long-term morbidity, where the presence of weak or damaged veins makes peripheral cannula insertion difficult, causing prolonged pain and trauma, even when specialist teams are involved (Barton et al, 2018). In such cases, a CVAD will not only provide more reliable access, but also will preserve these veins by not exposing them to irritant medications that can cause chemical phlebitis. This will reduce the discomfort, anxiety and pain associated with repeat cannulation (Barton et al, 2018).

Placement

A CVADs is defined as an intravascular catheter that terminates at or close to the heart, or is sited in one of the great vessels such as the superior and inferior vena cava (SVC/IVC) (National Healthcare Safety Network (NHSN), 2019; American Society of Anaesthesiologists Task Force on Central Venous Access et al, 2020).

Upper body CVADs should be positioned with the tip parallel to the vessel wall in either the lower SVC or the upper right atrium (RA) (Sousa et al, 2015). Ideally, the tip should lie proximal to the boundaries of the pericardial sac (Gibson and Bodenham, 2013).

There is debate on whether the tip should be placed in the right atrium. When placed in the lower SVC, the short catheter length can make a CVAD prone to internal malposition. It can slip into the innominate vein, increasing the risk of thrombosis.

Placement of the tip within the pericardium can potentially erode the vessel wall, causing serious complications (Jamshidi, 2019). including local venous thrombosis, catheter dysfunction and retrograde flow in the direction of the head (Roldan and Paniagua, 2015). Despite decades of debate, there is still no consensus on this. Therefore, the accepted tip location, is the approximate region of the lower SVC/ cavoatrial junction (Anh et al, 2017; Jamshidi, 2019)

Composition

CVADs are composed of either polyurethane or silicone.

Silicone catheters are softer and more flexible than polyurethane ones. The thicker catheter wall results in a smaller internal diameter, with larger catheters required to achieve the same flow rates. Larger catheters generally cause more phlebitis; silicone catheters are less stiff, so result in less trauma to the vascular endothelium (de Lutio, 2014).

Polyurethane catheters have a larger internal diameter. Their walls are thinner and stronger than those of silicone catheters, and so they can tolerate power injection and higher flow rates, with a reduced risk of rupture (Seckold et al, 2015).

Both materials develop surface irregularities over time that can cause fractures, although this is more pronounced in silicone catheters (Blanco–Guzman, 2018). In recent years, the use of polyurethane has far exceeded that of silicone in peripherally inserted central catheters (PICCs) (Seckold et al, 2015). Recent studies on the use of forearm ports indicate that silicone might be preferable, despite the risk of fracture and mechanical complications, as there is a lower risk of infection, occlusion and need for removal (Blanco–Guzman, 2018).

Types of central vascular access device

Acute non-tunnelled

Acute short-term non-tunnelled catheters are usually placed in the internal jugular, subclavian or femoral vein, and remain in place for fewer than 14 days (*Figure 1*). They are preferred for patients who are haemodynamically unstable or receiving vasopressors, and are used to monitor central venous pressure, administer medications, fluids and parenteral nutrition in intensive care and/or high dependency areas, and for repeated blood sampling (Chopra et al, 2015).

Non-tunnelled CVADs have single or multiple (up to seven) lumens, which will increase the frequency of manipulation (Sousa et al, 2015). They have the highest rate of catheter-related bloodstream infection (CRBSI) due to the potential for microorganisms on the skin to migrate from the insertion site along the external surface of the catheter.

Peripherally inserted central catheter

PICCs are a safe and reliable form of IV access (Seckold et al, 2015). They are inserted in one of the peripheral veins in the upper arm (cephalic, brachial or basilic) and threaded up the vein until the SVC is reached (*Figure 2*). They are appropriate for infusion therapy durations of more than 15 days (ie, medium- to long-term) (Chopra et al, 2015).

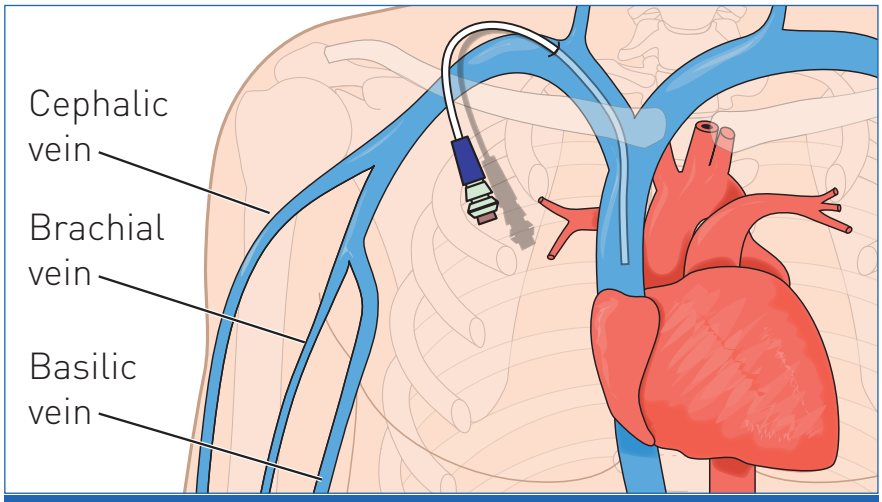
PICCs have an advantage over other types of CVADs as there is a reduced risk of serious complications during insertion. Pneumothorax, haemothorax and other injuries associated with direct puncture of the great veins in the upper thorax are avoided, infection rates are often reduced in outpatients, there are fewer delays in insertion, and costs are reduced as nurses often place PICCs at the bedside (Chopra et al, 2013; Johansson et al, 2013). As they are associated with lower risks during insertion, PICCs can be preferred to short-term acute CVCs in patients with coagulopathy, especially if the proposed use is more than 15 days (Chopra et al, 2015).

Like all CVADs, PICCs are associated with CRBSI (Chopra et al, 2013). The main causes are intraluminal contamination, which occurs when the hub is contaminated by bacteria on the patient's skin or health professionals' hands, or as a result of extraluminal contamination or poor skin disinfection of the insertion site (Coyne and Jose, 2017).

As they are inserted into veins with a smaller diameter and pass through a greater area in the upper extremity, PICCs are associated with a higher risk of thrombosis than other long-term central venous catheters (Infusion Nurses Society (INS), 2021), which affects their longevity (Sousa et al, 2015).

PICCs should be avoided in patients with chronic kidney disease, due to the risk of central venous stenosis and occlusion (which can prevent future haemodialysis) and the formation of an arteriovenous fistula or graft (INS, 2021; Chopra et al, 2015).

PICCs appear to be the most common long-term CVAD used. There is a limit to how long they can remain in place (Barton et al, 2018). When in situ for more than one year, a longer-term device, such as a port, should be considered, due to the increased risk of infection and thrombosis.



Illustrations: Peter Lamb

Figure 1. Acute non-tunnelled catheter

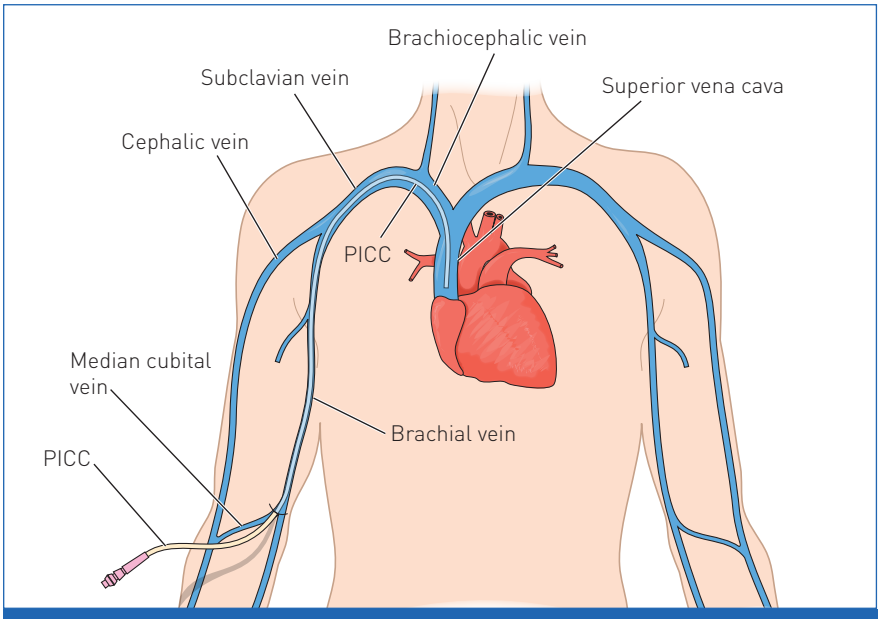


Figure 2. Peripherally inserted central catheter

Tunnelled central venous catheter

A cuffed tunnelled CVAD is used for long-term administration of IV medications or fluids, and is appropriate for when a device needs to remain in place for at least 3 months (Chopra et al, 2015).

The insertion site is typically the internal jugular vein and the exit site the chest wall (*Figure 3*). Like PICCs, they are composed of either silicone or polyurethane and can be single- or multi-lumen. Tunnelled cuffed CVADs, in the form of a permacath, can be used for dialysis or apheresis.

Ports

Patients requiring long-term intermittent (weekly or monthly) venous access are suitable for placement of a totally implanted port (Walser, 2011). A port can remain in situ indefinitely and be used to administer therapy for 6 months or more (Chopra et al, 2015).

Implanted subcutaneously through a small incision in the skin, a port consists of a reservoir and a catheter that is tunnelled and inserted into the vein (Tabatabaie et al, 2017; Kelly and Moss, 2016) (*Figures 4–6*). The external housing, which is composed of

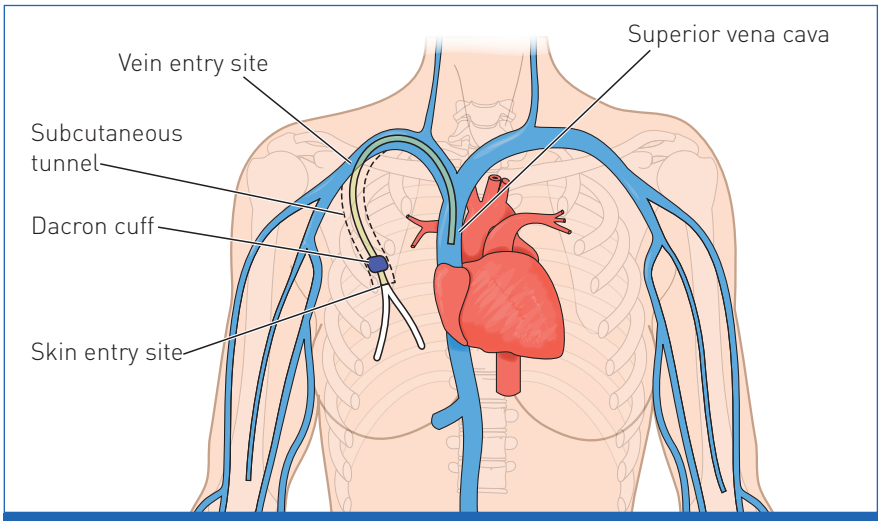


Figure 3. Tunnelled central venous catheter

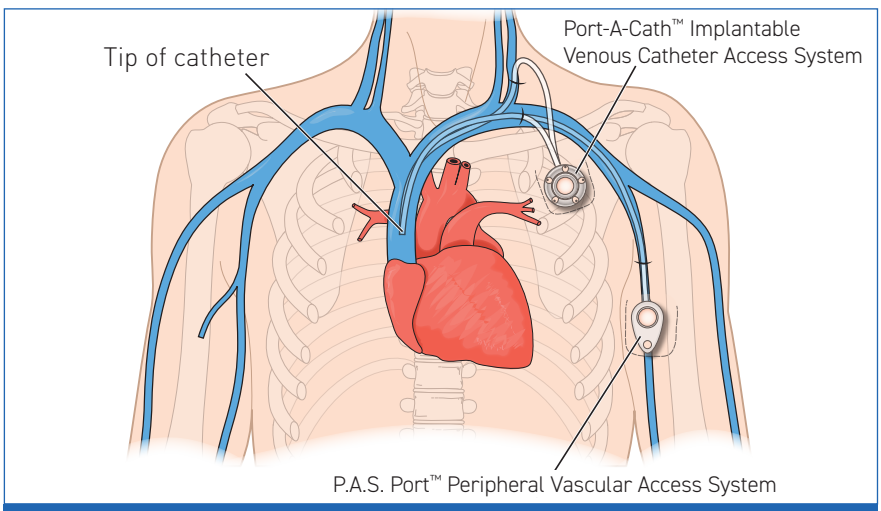
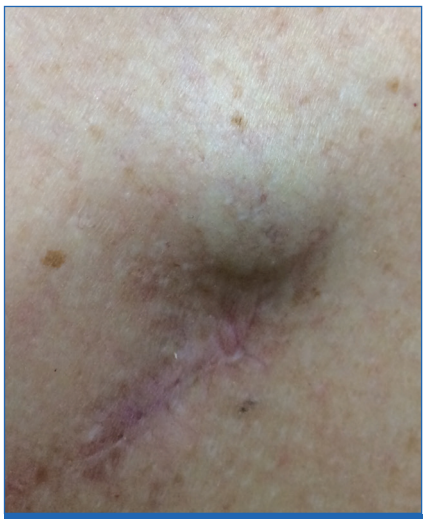


Figure 4. Totally implanted port



Courtesy of Nicole Moodley and Jacqui Williams

Figure 5. Port in situ

titanium or polyurethane (or both), contains both the reservoir and a self-sealing silicone septum, which faces the skin (Tabatabaie et al, 2017; Dougherty, 2011). Depending on the size of the port, the silicone rubber septum can be punctured between 1000 and 2000 times, making it suitable for long-term use (Blanco-Guzman, 2018).

Like other mid- to long-term CVADs, port tubing can be either open or closed ended. Closed-ended catheters, which have valves, are designed to prevent unintentional reflux of blood into the tubing when the needle is removed (Blanco–Guzman, 2018).

However, a randomised controlled trial found that Groshong closed-end catheters were not superior to traditional open-ended catheters in their ability to prevent complications, such as the inability to draw blood samples (Pittiruti et al, 2014).

This was supported by Blanco-Guzman's (2018) literature review, which found that proximal rather than distal placement of pressure-activated safety valves may help to avoid clotting and occlusion, but will not prevent early and late complications.

Ports come in a range of sizes. Standard-sized ports can be used for any patient, although low-profile ports may be preferred for thin patients and children, or for their cosmetic appeal (Scales, 2010; Dougherty, 2011).

Some ports are designed to tolerate power injection and will have a computer tomography (CT) mark to denote this.

Ports are also available with single or double lumens, with the latter having two separate reservoirs, each with its own catheter and septum in a single port body (Arch, 2007). When using a double-lumen port, each septum must be accessed for simultaneous infusion of separate incompatible medications or fluids (Dougherty, 2011).

Double-lumen ports have been used for apheresis since the 1990s. In April 2017, the US Food and Drug Administration (FDA) approved the first port specifically designed for long-term apheresis. This is not yet available in the UK (Blanco-Guzman, 2018).

Ports have the lowest risk of CRBSI as there is no external site into which microorganisms can enter when the device is not being accessed (Sousa et al, 2015).

Chest versus arm placement of ports

Ports are most commonly inserted in the upper chest, which has lower complication rates for thrombosis and infection than alternative sites (Marcy et al, 2015; Barton et al, 2018). Ideally, ports inserted for vascular access are placed on the rib to provide support for access and stability (Dougherty, 2011). However, if the patient will be self-accessing the port, placement low on the side of the chest/abdomen is beneficial (Dougherty, 2011).

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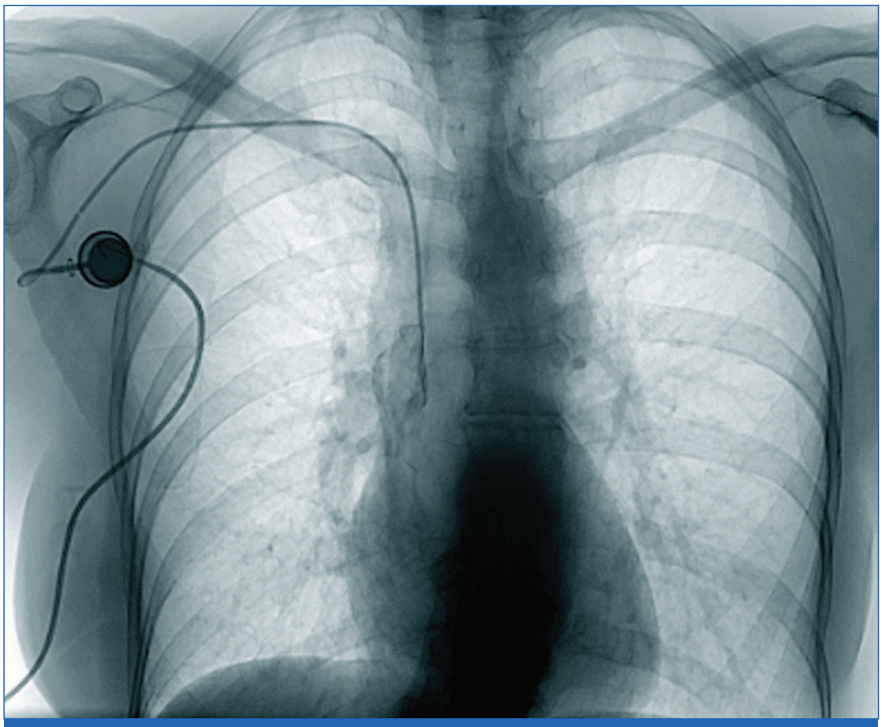

Figure 6. X-ray of a port in situ

The arm might be an easier or preferable alternative when chest implantation is contraindicated in patients with breast, head and neck cancer, or in patients who are obese or need to be in an upright position during insertion due to respiratory insufficiency (Marcy et al, 2015; INS, 2021). Goltz et al (2013) found that patients with upper arm placement had less 'foreign body perception' when compared with those who underwent chest placement, as they perceived the port to be lighter and smaller. Shiono et al (2014) suggested that arm placement might be less frightening for patients than traditional subclavian or internal jugular puncture, as it does not leave scars on the neck or chest and is easier to access without removing clothing.

Other advantages of placing ports in the arm include (Shiono et al, 2014; Tabatabaie et al, 2017):

- No risk of pneumothorax
- Ultrasound can be used to provide real-time visual guidance during insertion
- The basilic vein can be used, which will avoid accidental arterial cannulation and bleeding as it is not close to any arteries
- Any bleeding can be easily stopped by applying direct pressure.

For patients with a history of multiple central venous catheterisation, bilateral breast cancer, infected tissue or post-radiogenic dermatitis of cutaneous metastasis, there is the option to place the port in the femoral vein via the IVC (Kato et al, 2016).

Insertion technique

Ports must be implanted in a clinical environment that is designed for CVAD insertion, such as interventional radiology, an operating theatre or other designated procedure rooms. The procedure must be performed within strict aseptic conditions, using a local anaesthetic with or without sedation (Burbridge et al, 2000; Hamilton and Bodenham, 2009; Sousa et al, 2015).

There are two methods of insertion:

- Surgical (open or cutdown) (*Box 1*)
- Seldinger approach (*Box 2*).

With the cutdown approach, the cephalic or, less commonly, the external jugular vein is exposed during surgery and the catheter is inserted. With the Seldinger approach, the catheter is inserted directly into the central vein (Tabatabaie et al, 2017).

The Seldinger approach is more popular as it does not take long to complete, can be performed in an outpatient setting and there is great flexibility of percutaneous cannulation (Pittiruti et al, 2016).

Designed to help prevent the risk of air embolism and unnecessary blood loss, a valved introducer can be used to dilate the vein when the guidewire is inserted to allow passage of the catheter. Fluoroscopy is a useful tool for visualising the passage of a guidewire and its manipulation in real time (Jamshidi, 2019). X-ray is the gold standard for imaging (Bodenham et al, 2016).

The presence of adequate subcutaneous tissue over the port will prevent erosion. However, too deep a placement might make it more difficult to access (Dougherty, 2011).

The insertion site will be tender and oedematous for up to 1 week post-implantation, and any manipulation will be painful. Therefore, if the port is needed for immediate use, it should be accessed and dressed at the time of insertion (Dougherty, 2011).

Accessing and de-accessing a port

Health professionals should receive specialist training before they can access and de-access implanted ports (Arch, 2007; INS, 2021; Royal College of Nursing (RCN), 2016). Lack of experience, confidence and skill in accessing a port can cause patients anxiety and trauma (Dougherty, 2011; Barton et al, 2018).

Before accessing the port, any patient fears or preferences about pain control should be explored (Gorski et al, 2010). If required, local anaesthetic cream can be applied. With time, the skin over the port usually becomes desensitised, reducing the need for this.

Ports should be accessed, using ANTT, with the smallest sized non-coring (Huber-point) needle (*Figure 7*). Normal standard hypodermic needles should never be used, as bits of the silicone septum might get caught in the needle lumen, resulting in leakage (Gorski et al, 2010).

Non-coring needles have bevels that are flat or off-set (Dougherty, 2011), and come in a range of gauges (g) (19–22 g) and lengths (16–32 mm). If it is not known what the appropriate needle gauge for the patient is, the mid-sized 20 g by 25 mm non-coring needle should be used. Smaller needles are used in ports that are close to the skin

Box 1. Surgical or open technique

Using an open cut-down approach, the cephalic vein is isolated at the deltoid deltopectoral grove. An incision is made over the area of the cephalic vein. Using blunt dissection, the vein is exposed and incised. An insertion guide helps introduce the catheter into the vein. The pocket is created, and the catheter is trimmed to the appropriate length and, if not pre-attached, is attached to the port housing, which is sutured in place to the underlying fascia. If used, the sutures are placed laterally, medially, superiorly or inferiorly to the septum to avoid the area where the port will be accessed (Dougherty, 2011; Biffi et al, 2014)

Box 2. Seldinger approach

Using ultrasound or fluoroscopy, the vein selected is accessed. A flexible J tip guidewire is inserted into the needle. The vein is dilated using a tapered tip dilator, which is exchanged for a peel-away introducer. The peel-away sheath is used to insert the catheter into the lower third of the superior vena cava, and then extracted. The catheter or port assembly is tunnelled or surgically placed, usually on the chest wall. The pocket is created just under the skin (0.5–1.0 cm). The catheter is cut to the appropriate length and, if not pre-attached, connected to the port housing. The housing is sutured in place (Galloway and Bodenham, 2004; Burbridge et al, 2000; Dougherty, 2011)

surface. Patients should be made aware at the time of insertion of the appropriate needle size for their port.

The needle should sit flush on the skin, with the bevel pointing in the opposite direction to the port body: more protein is removed when flushing in this orientation (INS, 2021).

When required, gauze can be placed under the port needle to increase stabilisation and reduce the risk of skin trauma; a sterile dressing can then be applied (Dougherty, 2011; INS, 2021; RCN, 2016). Many devices come with a non-absorbent foam padding, which creates a stable platform and offers additional patient comfort. As with all CVADs, the needle must be in the correct position before blood is aspirated prior to use.

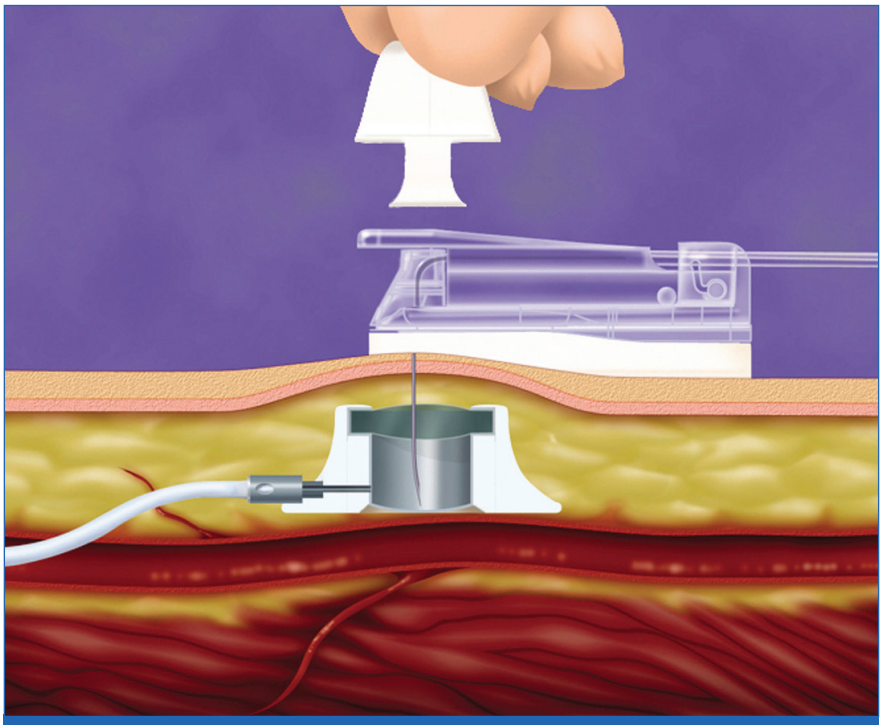

Figure 7. Placement of a port and a non-coring needle, illustrated with a Gripper Plus™ (ICU Medical)

Incorrect use or placement of the needle in the port (for example, if the access needle is too short or poorly secured) can result in infiltration and extravasation (Boschi and Rostagno, 2012; Barton et al, 2018). Safety needles, which have a low profile and lock into place, may increase comfort and stability, thereby reducing these risks.

If withdrawal or total occlusion occurs, making it impossible to aspirate blood return, the catheter must be inspected and the cause of the obstruction addressed. If thrombotic occlusion has occurred, thrombolytic agents may need to be administered. If all attempts to clear the obstruction fail, the port may need to be removed (Blanco–Guzman, 2018).

Most non-coring needles have safety features designed to comply with legislation and guidance on avoiding sharps injuries.

Implanted ports only require post-insertion care until the incision is healed (Sousa et al, 2015).

When de-accessing the port, current recommendations are to flush it every 4 weeks (INS, 2014; RCN, 2016). A literature review by Blanco-Guzman (2018) found that recent studies have demonstrated that flush/lock intervals of up to 12 weeks are safe.

Which device?

The vessel health and preservation (VHP) framework should be used to help guide this decision-making process (Ahn et al, 2017). The device chosen should meet the need for IV therapy, while reducing risk and unnecessary patient harm (Moureau et al, 2012). Preservation of vessels will prevent complications (Hallam et al, 2016).

Figure 8 can be used to aid decision-making. The first step is to determine if the IV therapy needs to be delivered centrally or peripherally. If centrally, the intended duration of therapy must be considered. Unfortunately, evidence on how to choose one type of CVAD over another is lacking.

If the device will be used for long-term therapy, selection will be determined by whether this will be continuous or intermittent.

The case for ports

Ports have been found to have lower overall complication rates, with significantly fewer thromboses, when compared with PICCs (Patel et al, 2014; Herd et al, 2018). As they do not compromise patient mobility or movement, they are regarded as ideal for long-term therapy (Arch, 2007; Tabatabaie et

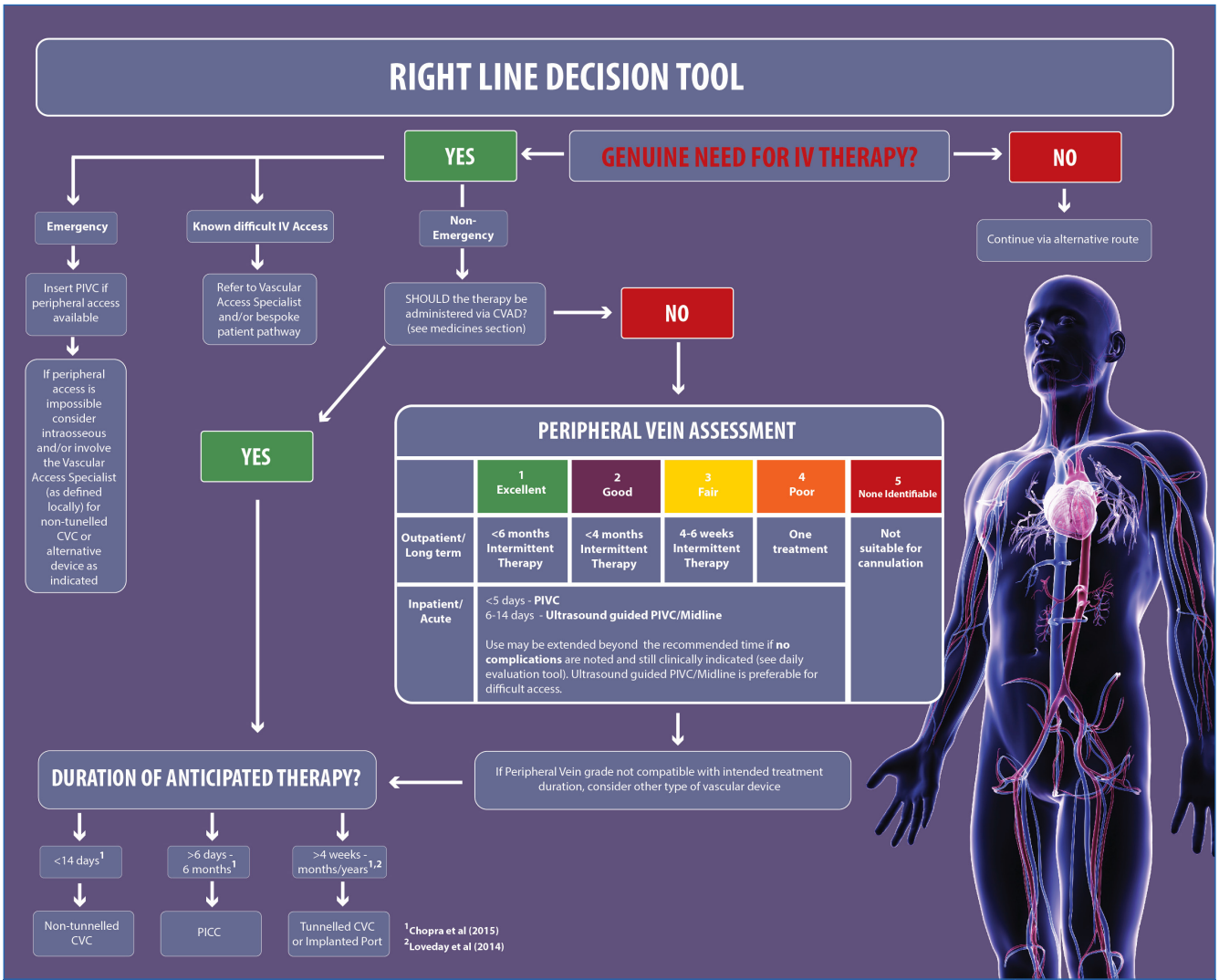

Figure 8. The right line decision tool (Hallam et al, 2020)

al, 2017). Patients with an active lifestyle may find that the presence of a PICC or tunnelled line limits their ability to go swimming or participate in pursuits involving the repetitive use of their upper extremities. Implanted ports make long-term intermittent therapy more patient- friendly (Arch, 2007).

When not being accessed, ports minimise the need for aftercare, allowing patients to resume their normal lifestyle and activities without the potential for dislodgement or risk of infection (Blanco-Guzman, 2018).

Compared with CVADs that have an external component, ports are more cosmetically acceptable to patients (Marcy et al, 2015).

It is important to involve patients in decision-making about selection. Patients' lifestyles, body image and ability to self-care must also be considered (Ongston-Tuck, 2012).

In the author's unit, all those involved in the care and management of implanted ports, including patients and carers, are offered education and training.

Conclusion

Ports are ideal for patients requiring long-term venous access. Education is key to assisting all staff in making the right decision regarding placement of the appropriate long-term central venous access. Given their low overall complication rates, ports should always be considered for this indication.

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Best practice for using implantable ports and non-coring needles

Nicola York and Andrew Barton

Ports are predominately inserted into oncology patients, but their use is becoming increasingly popular for other indications, such as cystic fibrosis.These devices not only provide patients and health professionals with reliable vascular access, but also preserve vessel health for future use. This article explores the additional equipment required to be able to access ports. It reiterates the need for education on the use of these devices, as this will help increase their longevity

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Access and de-access | flushing | high-pressure injection | complications

Due to their reliability and patient benefits, implantable ports (also known as totally implantable venous catheter access systems or devices) are increasingly becoming the central vascular access device (CVAD) of choice for patients requiring long-term intravenous (IV) therapies (Hodson, 2019) This article discusses the best practice for their use.

Choosing a non-coring needle

Ports, which are manufactured in steel, titanium or plastic, are accessed through a self-sealing silicone rubber septum (Wynne, 2021). A standard hypodermic needle should never be used for this, as it can core out a piece of the septum, which could then be injected into the patient. Therefore, non-coring (Huber-point) needles are used instead.

When accessing a port, it is essential to use the most appropriate non-coring needle to administer the prescribed medication. Non-coring needles have an open, tapered end, whereas standard coring needles have an opening on the side (Nourbakhsh et al, 2013). The 45-degree angle at the end of a non-coring needle prevents it from coring out plugs of silicone from the septum or tissue when accessing the port and inadvertently administering them systemically into the patient. *Box 1* lists the advantages and disadvantages of non-coring needles.

It is crucial to choose a size of non-coring needle that matches the port. When selecting the size, the depth of the port reservoir and the thickness of the tissue covering the port must be considered, to ensure the needle is flush against the patient's skin. The port should be examined before each access and the length of non-coring needle used documented in the patient's notes. The length required may change if the patient loses or gains weight. BoIn the event of weight loss, subcutaneous fat and skin will become thinner, so a shorter needle will be needed to avoid port erosion. If the patient gains weight, a longer non-coring needle might be required.

Non-coring needles are available in different lengths (16–32 mm) and diameters (19–22 gauge). The length and gauge of the needle chosen will depend on the treatment or reason for access. In addition, non-coring needles are available in both safety andnon-safety designs (Meade et al, 2019). A safety device will help prevent needlestick injuries and exposure to blood-borne pathogens; health and safety legislation from 2013 is still current and in force to help prevent needle stick injuries (Health and Safety Regulations, 2013).

Flushing the port

Ports need to be flushed to ensure that blood or medicines are cleared from the device, as otherwise they might adhere to the internal surface of the catheter. There are two main methods for flushing a port:

- Turbulent method
- Positive pressure technique (Hadaway,

Box 1. Advantages and disadvantages of non-coring needles

Advantages	■ Hollow with a long-bevelled tip ■ The deflective non-coring tip will part the septum on entry and removal, allowing the septum to reseal itself ■ Prevents silicone particles punching out of the septum ■ Power injectable non-coring needles can administer contrast infusions at a rate of 5 ml/second at a maximum of 300 PSI ■ Safety non-coring needles reduce the risk of needlestick injuries and exposure to blood-borne pathogens
Disadvantages	■ Usually stored in specialist areas, so the stock is limited ■ Specialist training is required on insertion ■ If the needle has a non-safety design, there is an increased risk of needlestick injury and exposure to blood-borne pathogens ■ If the needle is too short, it might not penetrate the port reservoir sufficiently, placing the patient at risk of extravasation or infiltration ■ If the needle is too long, it could damage the integrity of the port's septum and shorten its life

2006; Goossens, 2015, Boord 2019). The turbulent method uses a push-pause method to inject the flush solution into the intravascular catheter.

The positive pressure technique uses a smooth flush. The catheter is clamped while the last part of the flush is being instilled, leaving 0.5–1 ml of solution in the syringe. Immediately after this, the pressure on the syringe is released (Royal College of Nursing (RCN), 2016; Infusion Nurses Society (INS), 2021).

A patient benefit of ports is that they only need to be flushed every 4 weeks, in some centres the duration between port flushing has been extended since COVID, there is published evidence demonstrating that up to 3 months between flushing can be safe and affective (Oh et al, 2021; Wang et al, 2022).

To promote longevity of the device, some clinical areas advocate instilling 100 units/ml of heparin lock solution into the device, as this will help ensure its patency (INS, 2021).

Non-coring needles should be removed and discarded in accordance with local policy (RCN, 2013).

Accessing a port using a non-coring needle

Ports must be accessed using the Aseptic Non Touch Technique® (ANTT) (ANTT, 2010; Cullinane 2019; Rowley and Clare, 2019). The following equipment is required to access a port:

- Plastic tray
- Sterile or non-sterile gloves, depending on local policy
- Chlorhexidine gluconate 2%, isopropyl alcohol 70%: 3 ml sponge applicator
- Luer lock syringe: 10 ml x 2
- 10 ml sodium chloride 0.9% for injection
- Heparinised saline or saline (referring unit will give instructions on the dose)
- Non-coring (Huber-point) needle 20/22 gauge (appropriate length)
- One blunt fill needle
- One blunt filter needle

If the non-coring needle will be left in situ, a semipermeable dressing and needle-free connector (NFC) will be required.

Portacator

A Portacator (*Figure 1*) is a plastic disc with a hole in the middle, the portacator is placed onto the skin over the implanted port, the portactaor stabalises the port and allows the operator to locate the centre of the port, allowing a non-coring neelde to be inserted precisely into the centre of the port. This device increases the chances of successful onocoring neelde insertion (Barton et al, 2018).

Table 1 gives a step-by-step account of how to access a port.

Removing the non-coring needle

Before removing the non-coring needle, consider using heparinised saline in accordance with the unit's and manufacturer's guidance (INS, 2016).

The needle should be removed using ANTT and personal protective clothing (PPE) worn. To remove the non-coring needle or de-access the port, relocate the port by placing the first and middle fingers of the non-dominant hand on either side of the device and, using the safety mechanism, gently but firmly pull out the needle.

Discard the needle in accordance with local guidance (RCN, 2013). Document this in the patient's notes.

High-pressure injection

Power-injectable needles are manufactured to allow contrast medium to be administered intravenously by a power injector. These needles can withstand high pounds per square inch (PSI) pressures; the pressure limit for injecting contrast via a power injectable port is 3–5 ml at 300 PSI (Teichgraber et al, 2012; Son et al 2020). As such, they can ensure high flow rates (up to 5 ml/second) to provide enhanced angiographic studies.

Power injectable needles are available in a range of sizes and lengths, and with or without Y sites. Some manufacturers add a blue extension line and clamp markings to make these needles easily recognisable.

Power injectable ports come in different profiles and materials (titanium, polysulfone/titanium or plastic). The port septum is manufactured with a highly compressed silicone membrane, which allows the septum to close securely, holding the non-coring needle firmly in place. Power-injectable port catheters are normally made from polyurethane, which tolerates high PSI pressures; a silicone catheter will fracture when subjected to high PSI pressures (Nourbakhsh et al, 2013; Fielding et al, 2020).

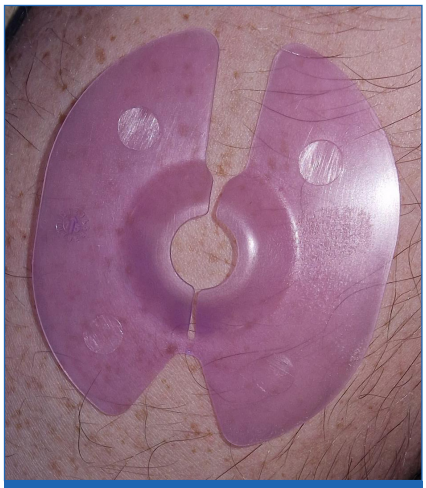

Figure 1. Portacator

The type of port implanted into the patient must be identified before access to ensure the correct port needle is used. If the port cannot be identified as power-injectable, it cannot be used for computed tomography (CT) scanning, due to the risk of rupture (Smith, 2008). On some ports, the term CT is written on the base to aid identification during CT scans and X-rays. Other ports are triangular, with three bumps on the septum that are easy to feel, or round.

All power-injectable ports come with identification cards, which should be given to the patient at implantation, along with an explanation. Patients should be encouraged to inform health professionals at each relevant consultation that they have a power port in situ. They should also be advised to keep the card with them in case they require a CT scan and to present the card to avoid insertion of unnecessary peripheral cannulas.

How to care for an unaccessed port

Key principles of the care for unaccessed ports are described in *Box 2*.

Potential complications

Potential complications of incorrect placement or use of the wrong-sized needle are extravasation and infiltration. These can occur if the non-coring needle is incorrectly placed into or dislodged from the port septum (Schulmeister and Camp-Sorrell,

Table 1. How to access a port

Action	Rationale
Confirm the patient's identity using positive patient identification	To ensure correct patient identification and safety
Explain and discuss the procedure with the patient, obtaining their verbal consent. Check for any known allergies	To inform the patient and give them an opportunity to discuss this and time to ask questions
 Clean hands with soap and water or an alcohol hand rub. Clean the tray with a clinical wipe and allow to air dry as per local policy. Collect the equipment	To reduce the risk of infection
 Ensure the patient is in a comfortable position, locate the port and identify the septum. Assess the depth of the port and the thickness of the overlying skin	To ascertain which size and length of non-coring needle to use and to identify whether or not a power port has been implanted, and therefore whether a power-injectable non-coring needle is required
 If required, apply prescribed topical local anaesthetic cream for 30–60 minutes before accessing. Check the patient's prescription	To help prevent pain when the port is accessed
Apply apron. Clean hands with soap and water or an alcohol hand rub. Prepare the equipment. Protect the key parts, such as the syringe and non-coring needle, from contamination and ensure an appropriate non-coring needle for the port has been selected. Put on sterile or non-sterile gloves, in accordance with local policy	To prevent infection
Prime the non-coring needle with the 0.9% sodium chloride. Leave the syringe attached and close the clamp on the extension tube	To ensure the needle is patent and prevent entrapment of air
Clean the skin covering the port thoroughly and gently with a single-use applicator impregnated with chlorhexidine gluconate 2% and isopropyl alcohol 70% and allow to dry (Loveday et al, 2014)	To reduce infection
 Insert the non-coring needle through the patient's skin at a 90 degree angle. When it hits the back-plate, aspirate at least 2–5 ml of blood to ensure correct placement (RCN, 2016). If unable to aspirate, flush with 2–4 ml 0.9% sodium chloride and try to aspirate blood again	To check for blood return and ensure that the non-coring needle is in the correct place, which will avoid extravasation; To prevent infection
 Ensure that a needlefree connector is attached	To prevent reflux of blood into the port catheter, which could cause a blockage and make the catheter unusable or increase the risk of infection
 Flush with at least 10 ml 0.9% sodium chloride for injection using a push-pause technique (RCN, 2016; INS, 2016). ■ If resistance, pain, inability to flush or swelling occur, stop flushing ■ If resistance is felt when the needle is believed to have been placed correctly, seek expert advice ■ If there is any doubt that the needle is not correctly sited, remove and insert a new one	To remove any medicine or blood debris from inside the catheter

Table 2. How to access a port (continued)

Action	Rationale
 Administer the prescribed medication and then flush with at least 10 ml 0.9% sodium chloride using a push-pause technique. Discard waste. Remove gloves and clean hands and tray. Sign the medicine chart in the patient's electronic patient's record	N/A
If the non-coring needle is to be left in situ, cover with a semipermeable transparent dressing and write the date on it	For ongoing management, the non-coring needle should be changed every 7 days
Before removing the non-coring needle, consider using heparin or saline in accordance with the unit's and manufacturer's guidance (INS, 2016)	N/A

Please note that the procedure may vary between wards
Reproduced with permission, Hallam et al (2016)

Box 2. How to care for an accessed port

1. Immediately after a port has been inserted, the wound should be covered with a transparent dressing (with or without gauze). After this, no further dressings or exit site care are required
2. Patients can bathe, shower or swim freely once wound has healed
3. Monitor for signs of port infection: redness, swelling, pyrexia (raised body temperature) and exudate
4. Monitor for signs of thrombosis, pain and swelling. If placed on the arm, there may be some discolouration of the limb
5. Give relevant contact details to the patient and inform them of the signs and symptoms of potential complications. Supply a port card and patient information leaflet in case of emergency

2000). If this occurs after vesicants have been administered, the degree of tissue injury can be severe enough to result in necrosis, which may require skin grafting.

Risk-management strategies will prevent or minimise such complications. These strategies include careful assessment and management of ports, provision of comprehensive education for health professionals and patients on the risk of extravasation, implementation of measures to decrease the risk of needle dislodgement, and the development and dissemination of policies on the management of port extravasation (Schulmeister and Camp-Sorrell, 2000; Xie et al, 2023).

It is imperative, therefore, that health professionals understand the rationale for checking blood return, which confirms patency. This will also enable the port's function to be assessed before the prescribed medication is administered, which will prevent complications such as extravasation or infiltration.

Table 2 provides a summary of strategies for managing and troubleshooting complications in port.

Education

Implanted ports have proved to be a reliable CVAD for the administration of IV therapy in hospital and ambulatory care and by home care companies. More patients are receiving treatments at home, which is helping to alleviate pressures on hospital beds. When a patient has a port inserted, therefore, it is imperative they are educated and warned of the risks associated with it. They should be informed of what the port is made (titanium or plastic) and if it is a power-injectable device, to prevent unnecessary insertion of cannulas. They should also be taught the importance of observing for the signs and symptoms of infection and complications such as thrombosis when at home.

It is essential that patients receive written information, including emergency telephone numbers, the type of port placed and how to prevent or minimise complications. To improve patient outcomes, health professionals need specialist training on how to access and manage ports. Likewise, educating patients on how to recognise complications will increase the longevity of the device inserted.

Conclusion

Ports are becoming more popular in the world of vascular access, as they are relatively easy to care for and give patients more freedom to carry out their everyday activities. However, health professionals must be educated and trained on how to access and recognise complications with ports should they occur. Likewise, educating patients on the care and management of their port is paramount in increasing its longevity.

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Table 2. Managing and troubleshooting complications of ports

Complication	Management
Systemic infection ■ Patient complains of a general feeling of being unwell and pyrexia ■ Rigors on flushing a port	■ Using an Aseptic Non-Touch Technique® (ANTT), first take blood cultures from peripheral lines and then from the port ■ If the port is a dual or multiple lumen, blood cultures should be taken from all lumens and labelled to identify which chamber the culture was taken from ■ Monitor the patient for signs of deterioration ■ Refer the patient to the medical team and ask for microbiology review
Port pocket infection ■ Patient complains of swelling, exudate, pain and there is redness surrounding the port pocket	■ Swab for microscopy, culture and sensitivity ■ Change the dressing. Do not use a dressing if an implantable port is not in use and the insertion sutures have been removed ■ Refer to the medical team and microbiology for review. Consider removing the port if unable to treat infection
Thrombosis ■ Patient complains of swelling, pain and engorged veins on the neck, chest or arm	■ Consider performing an ultrasound on the arm or neck ■ Consider starting anticoagulant therapy ■ Consider removing the port
Port occlusion (unable to aspirate blood) ■ The free-flow of fluids is sluggish or intermittent ■ Resistance is felt when flushing ■ The catheter/lumen is completely blocked	■ Use the push-pause technique when flushing the port ■ Use a positive-pressure needlefree connector ■ Consider instilling a thrombolytic agent when the port starts to feel sluggish during the administration of medications or when taking bloods. Also consider changing the patient's position by asking them to lie down, rotate their shoulder or drop their arm ■ Use a thrombolytic agent or alcohol if the patient is receiving parenteral nutrition
Port malposition/erosion ■ Internal catheter fracture ■ Fibrin sheath, which can be diagnosed using fluoroscopy ■ Separation of port and catheter	■ Check the non-coring needle is correctly placed ■ Stop using the port ■ Follow local guidance if extravasation occurs ■ Refer to interventional radiology for consideration of a lineogram ■ Remove the port if erosion occurs and consider inserting another form of intravascular device

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Clinical experiences of using ports and non-coring needles

Elizabeth Meade, Gema Munoz-Mozas and Nicole Moodley

The following case studies describe the use of ICU Medical's Port-A-Cath™ implantable venous catheter access system and P.A.S. Port™ implantable ports and Gripper™ Family non-coring (Huber-point) needles.

The implantable ports are easy to implant, maintain and remove. They are lightweight and have features that are designed to reduce complication rates, including a highly compressed septum to increase needle retention, a titanium chamber with a gouge-resistant floor, a bevelled chamber for optimal rinsing, a round shape to avoid overturning and the Ultralock connection. They are available in various configurations, with single and dual lumens. There is also a needle for power-injection of contrast media for certain types of diagnostic imaging scans (ICU Medical 18).

The non-coring needles are designed with an emphasis on safety, effectiveness and patient comfort. These non-coring needles have a bevelled tip that sits flush with the back of the port without impeding the flow of fluid; this also prevents holes forming in the septum (Barton et al, 2018). The needle is available in different gauges and lengths, which can be tailored to reflect individual patient needs and the amount of adipose tissue present. It is essential to select the correct size, which will reduce the risk of dislodgement. The non-coring needles are compatible with paclitaxel and lipid solutions, and they are recommended by the National Institute for Occupational Safety and Health (NIOSH) (1999).

Gripper™ Family non-coring needles are compatible with both Port-A-Cath™ implantable venous catheter access systems and P.A.S. Port™ implantable ports, and they can be ordered from the same manufacturer, which has the potential to make ordering, training and support more efficient.

Case study 1

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In July 2018, a 60-year-old woman was diagnosed with metastatic sigmoid colon cancer. She had presented with anaemia, crampy abdominal pain and constipation, and had developed subacute bowel obstruction. The staging computer tomography (CT) scan revealed multiple liver, peritoneal and retroperitoneal lymph node metastases. She underwent an emergency right hemicolectomy and, following her recovery, was referred to the oncology team for consideration of palliative chemotherapy.

The patient's tumour was a poorly differentiated adenocarcinoma, Ras wild type. Her initial treatment plan was folinic acid, fluorouracil and irinotecan (FOLFIRI)/cetuximab, with chemotherapy comprising 5-fluorouracil bolus and infusion, administered over 48 hours every 2 weeks for 6 months.

The current median survival duration for metastatic colorectal cancer is approaching 3 years. This reflects the availability of conventional cytotoxic agents and biologic agents that target angiogenesis and epidermal growth factor receptor (EGFR) (Heinemann et al, 2014).

Vascular access device (VAD) selection is based on the patient's diagnosis, prognosis and physical and psychological condition. Other influencing factors are the duration of treatment and chemotherapy regimen prescribed. Patients should participate in this decision-making, which can be facilitated by explaining to them the risks and benefits of each type of VAD and its potential impact on body image (Campbell, 2013).

This patient had poor venous access. However, there was potential for her to receive therapy for a number of years, with some regimens requiring central access. The consultant medical oncologist and oncology nurses explained to her the different VADs that could be used to administer the chemotherapy, including an implanted port and a peripherally inserted central catheter (PICC). To avoid anxiety about the prospect of numerous attempts to gain peripheral access, and due to her desire to continue looking after her grandchildren, the patient opted for an implantable port (Port-A-Cath™ implantable venous catheter access system, ICU Medical). She felt this would enable her to perform her daily routine more easily.

At the time of writing, the patient has completed 6 months of therapy without any complications such as infection or occlusion that might be associated with the insertion of the port. The patient commented that the port 'has made having chemotherapy a lot easier for me over the past few months. I was very anxious about [having] repeated blood sampling and needle insertions because my veins are so bad. The implantable port got rid of these worries.'

Treatment of metastatic colon cancer has evolved over the past few years. The choice of treatment to be used will be determined by the following considerations:

- Patient fitness
- Performance status
- Comorbidities
- DNA
- MMR deficiency
- High levels of MSI or RAS/BRAF
- HER2/Neu status
- Side of the primary tumour.

For example, patients with MMR deficiency are eligible for immunotherapy, and triple

chemotherapy may be used in fit patients who have a high burden of disease or aggressive cancer.

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Case study 2

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Our paediatric and young adult unit provides care to inpatients and outpatients aged 1–24 years with a wide range of haematology/oncology diagnoses. This case is about a 3-year-old boy who had been newly diagnosed with rhabdomyosarcoma (RMS) of the right leg, which required neoadjuvant chemotherapy followed by surgery. RMS is a type of soft-tissue sarcoma that grows in active muscles of the body. In the unit, the UK Vessel Health Preservation framework (Hallam et al, 2016) is used to select the best vascular access device to meet an individual patient's needs. In this case, the duration of treatment and practical issues, such as the possibility of the child pulling out the device or getting it wet when showering/bathing, were the main contributing factors. After discussion with the family, an informed decision was made to insert an implanted port. The device was inserted with no associated problems into the left chest wall via the left subclavian vein under general anasethetic by a paediatric surgeon.

The patient attended the day care unit for bloods and chemotherapy treatment on a regular basis. Before accessing the implanted port, to minimise any discomfort during insertion of the huber needle, a small amount of anaesthetic cream was applied over the port implantation area and left to take effect for 30–45 minutes. After an hour, the skin was decontaminated with 2% chlorhexidine gluconate in 70% alcohol solution and, using the Aseptic Non Touch Technique® (ANTT) approach, a paediatric nurse would access the port with a blunt cannula (Gripper Micro™, ICU Medical) (*Figure 1*). After the needle was inserted successfully, it was secured with a semipermeable transparent IV film dressing. The treatment was then delivered over the entire morning as per the chemotherapy proforma. During this time, our young patient continued to play happily while watching television or interacting with other children in the day care unit's playroom.

The blunt cannula's small design facilitates application of the securement dressing and allows it to stay in place. In our experience, compared with other types of non-coring needles, there is little risk of small children dislodging it when they are active or playing, as it sits flat against the skin. After the treatment, the blunt cannula was removed with ease and very little discomfort.

Case study 3

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Following a bone marrow transplant for the treatment of acute lymphocytic leukaemia (ALL), a 13-year-old girl had her skin tunnelled catheter removed due to poor function (the lumens were sluggish when flushing and often there was no blood return on aspiration). As vascular access was still required, due to her poor peripheral access, the patient and her parents were offered the choice of either a peripherally inserted central catheter (PICC) or an implantable port (Hallam et al, 2021). They opted for the port, saying that they did not wish to have a device with 'tubes hanging out' and wanted one requiring very little maintenance when not in regular use.

The port was inserted under general anaesthetic by a paediatric surgeon via the right subclavian vein and implanted under the skin on the right side of the chest with no associated problems.

One year after implantation, the port remains in situ for blood sampling and supportive therapy, when required. It is regularly accessed, in accordance with hospital policy, with a blunt cannula (Gripper Micro™, ICU Medical). Occasionally, the blunt cannula needs to stay in overnight, resulting in the patient going home with it in place. Its small size and the foam pad enabled this to happen in a successful and safe manner without compromising the patient's lifestyle. On many occasions, the patient has expressed how the implanted port had made it easier to perform daily activities, particularly showering or bathing, and commented that, during access, she often forgets the procedure is being preformed, as the blunt cannula is so small and the foam pad feels so soft against the skin.

In both case studies, the needles were removed without complications following completion of treatment or when no longer

Figure 1. The low-profile Gripper Micro™ (ICU Medical) blunt cannula and the safety mechanism, which has been removed as part of the insertion procedure

required. All our paediatric nursing team, who have been trained on how to access implanted ports with non-coring needles, say they prefer the blunt cannula over other similar products because of its slim and small design and, most importantly, for its safety features: following insertion of the blunt cannula into the port, the sharp can be safely removed and the blunt cannula locked into position, leaving a small, low-profile infusion site with a blunt cannula, minimising any risk of needlestick injury.

References

Hallam C, Weston V, Denton A et al. UK vessel health and preservation (VHP) framework: a commentary on the updated VHP 2020. J Infect Prev. 2021; 22(4):147–155. https://doi.org/10.1177/1757177420976806

Case study 4

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In April 2017, a 58-year-old woman was diagnosed with colorectal cancer and admitted to the Royal Brompton Hospital, London. Following the first consultation, her oncology consultant discussed the role of adjuvant chemotherapy in bowel cancer with her and the rationale for downstaging chemotherapy in the possible presence of metastatic disease. The patient consented to a 12-week cycle of chemotherapy treatment as an outpatient.

The patient was offered the choice of either a peripherally inserted central catheter (PICC) or an implanted port. She chose the port as she felt it would enable her to be active without the device being visible to others. She also did not want to have to worry about caring for a PICC.

Provision of treatment on an outpatient basis required collaboration between the chemotherapy day centre and the community collaborative intravenous (IV) therapy service. In May 2017, the Imperial hospital chemotherapy day centre referred the patient to the community collaborative IV service at Hounslow and Richmond Community Healthcare NHS Trust. The patient attends the chemotherapy day centre, where a clinician accesses the implantable port using a non-coring safety needle (Gripper Plus™, ICU Medical) and attaches the elastomeric pump, which delivers the fluorouracil (5FU) chemotherapy.

As part of the treatment regimen, after 46 hours of chemotherapy, a community nurse from the community collaborative IV service visits the patient at home. The implanted port is flushed with sodium chloride 0.9% 10 ml and the line locked with an injection of heparinised saline 10 IU/ml to maintain the patency of the port. A semipermeable dressing is applied after the non-coring safety needle has been removed. The community nurse visits and repeats this process after each chemotherapy cycle (twice monthly for 6 months).

The community nurses have highlighted to the IV nurse specialists within the community trust that the non-coring safety needle and the shape of the implantable port appear to reduce the risk of infection, as it does not leave any holes in the skin (*Figure 2*).

The IV nurse specialists at Hounslow and Richmond Community Healthcare NHS Trust provide an IV update for community staff, which involves a practical element, whereby the nurses practise accessing and de-accessing an implantable port using non-coring safety needles on a training mannequin. During the training, nurses are reminded not to re-engage the needle, as this could result in an accidental needlestick injury with a contaminated needle. The IV specialist nurses also highlight that failure to use the non-coring safety needle's safety arm correctly when removing the needle from the port could result in the needle tip re-emerging from the base. The importance of verifying that the correct needle length has been selected for both the port and patient is also emphasised. If it is too short, it may not completely pierce the portal septum, and the medication might be administered into the surrounding tissue and/or the needle become blocked.

The community nurses were encouraged to give feedback after the training session. They commented on how the implantable port and non-coring safety needle protected them from accidental contamination of patient blood and needlestick injury in the patient's home.

The community nurses from the collaborative IV service visited the patient over several months. The patient told them she was happy with her implantable port, had found it comfortable from the day it was implanted and that the procedure for inserting the needles was tolerable. She said that, for her, an implantable port was the best option for the delivery of treatment, as it enabled her to feel confident with her own body image.

The implantable port was in place for almost 2 years before it was removed and the patient began to undergo rehabilitation therapy.

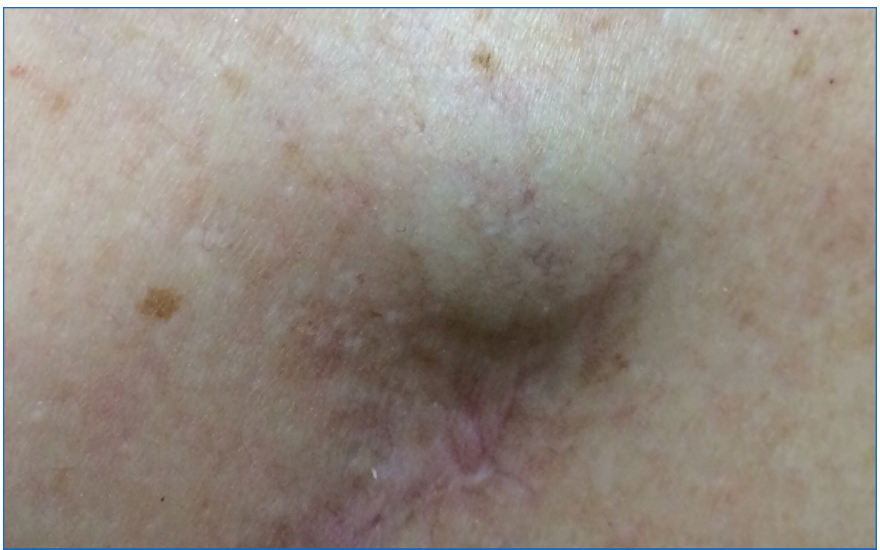

Figure 2. Patient's skin without holes, after removal of a Gripper Plus™ (ICU Medical) non-coring safety needle

Notes

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