Central Venous Access Devices in children; at a glance

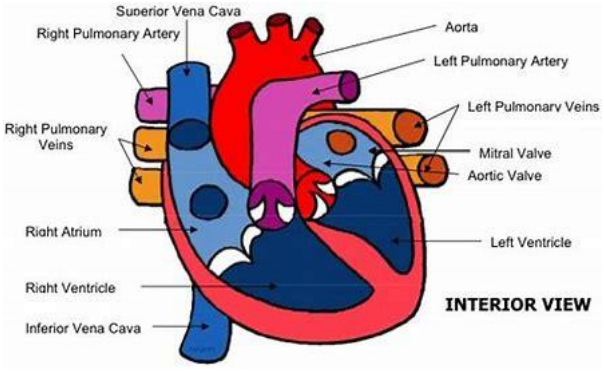
Introduction and indications

Central Venous Access Devices (CVADs) are commonly used in the medical care of children for both short- and long-term care. Healthcare professionals caring for children who have CVADs in place, are required to have a clear understanding of the benefits and risks associated with their use. This 'at a glance' article introduces the different CVADs commonly used in paediatrics and offers step by step guidance on the use and care of these devices.

NICE (2014) note that devices which provide vascular access to patients are one of the greatest causes of healthcare-associated infections. Furthermore, they note that bloodstream infections. associated with CVADs are a major cause of morbidity in patients (NICE, 2014). This reinforces the need for healthcare professionals caring for patients with CVADs to have an excellent understanding of infection prevention and control when using these devices.

Central Venous Access Devices

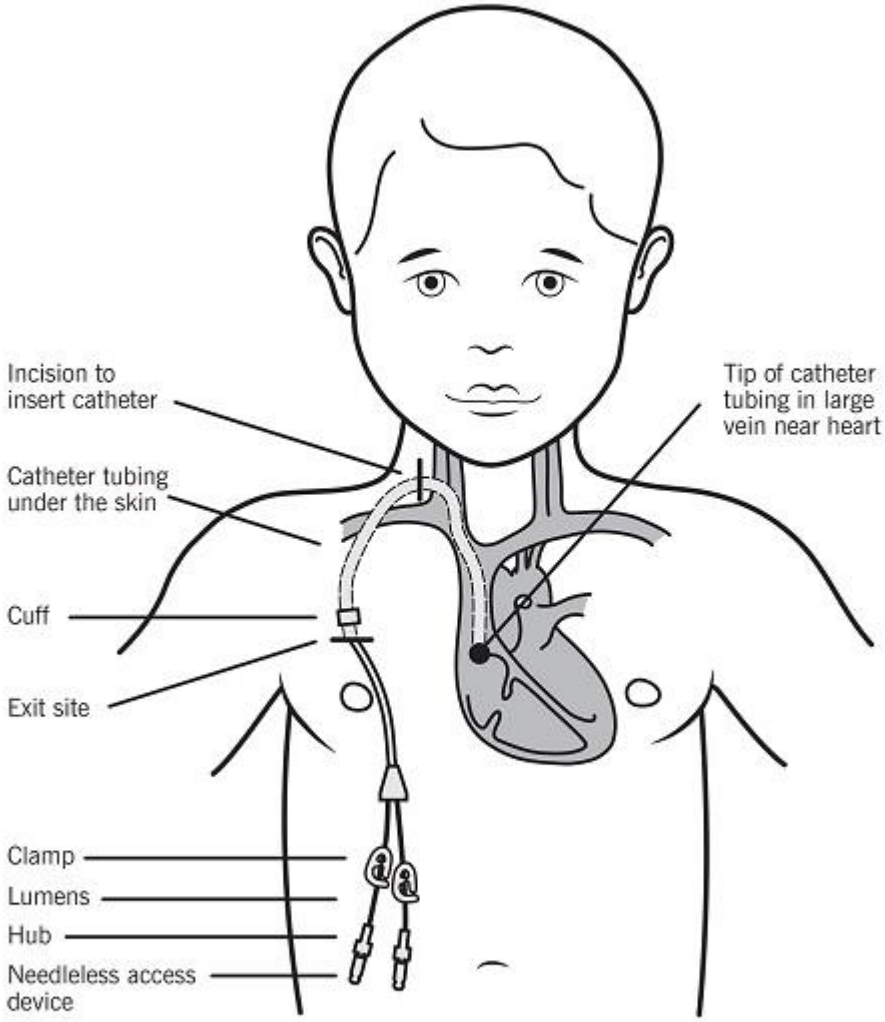
A CVAD is a catheter, which is inserted into a large vein in a child's body and leads to the heart. The catheter is inserted through the skin and the tip will usually sit in either the superior vena cava or caval atrial junction (Royal Marsden NHS Foundation Trust, 2016) (Please redraw this diagram of heart or similar).



A CVC was first inserted in 1929, and since this time, the use of CVADs in modern medicine has vastly grown and developed (Smith and Nolan, 2013). There are many different reasons why a child may need to have a CVAD inserted to provide access to large veins in the body, including; blood sampling, medication administration and central venous pressure monitoring in seriously unwell children. Table 1 displays the common CVADS used in Children, as well as their various uses, advantages and disadvantages.

Different Types of CVAD's used in Children

Tunnelled central venous catheter (Please redraw this picture of tunnelled central line or similar)



A tunnelled Central Venous Catheter (CVC) is sometimes known as a Hickman® or Broviac® line (named after the developers of each line). These catheters are tunnelled from an exit site, usually on the chest wall, up to the neck, where a small incision is made and the catheter is inserted into the superior vena cava (Children's Cancer and Leukamia Group, (CCLG), 2020). There is a cuff on the line which is used to fix the line in place under the patient's skin and the lines are initially surgically stitched into place. The tip of the tunnelled CVC usually sits at the entrance of the right atrium, providing access for blood sampling and drug administration.

Tunnelled CVCs will usually only have one tube within the catheter but is also possible to get double, triple, quad or quin lumen CVCs where the catheter will be divided into up to five lumens in order to use each lumen in a different way. This is particularly useful for patients who require many different

treatments simultaneously which may not be compatible, for example a patient who requires Total Parenteral Nutrition (TPN) at the same time as numerous IV medications.

None tunnelled central venous catheters

A none tunnelled CVC is very similar to a tunnelled catheter but the entrance point of the catheter to the body is directly through the skin and into the vein. None tunnelled CVC's are usually used for shorter term, emergency access and are inserted in central veins in the chest neck or groin.

Implantable Ports

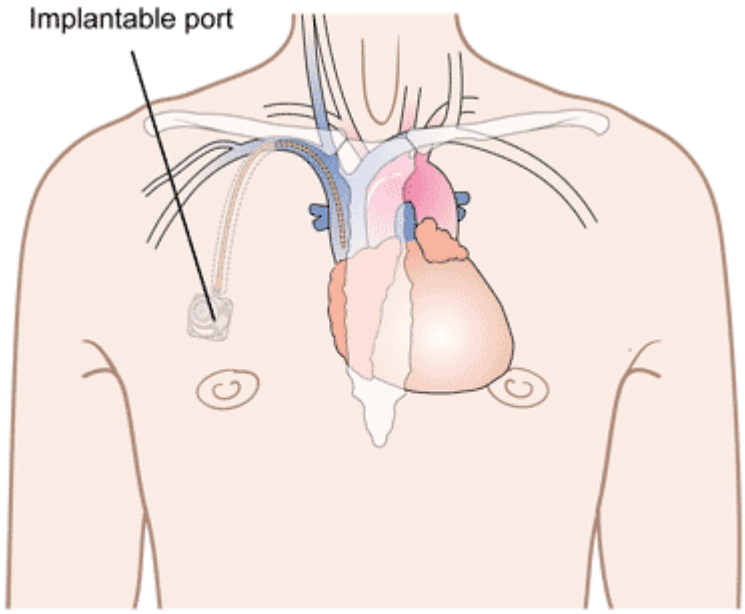


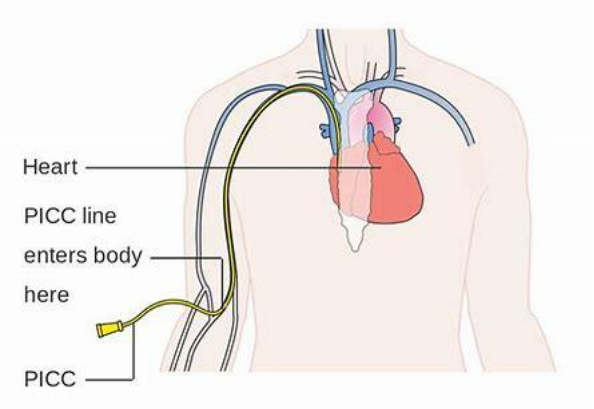
Diagram showing an implantable port
© CancerHelp UK

(Please redraw this picture of an implanted Portacath or similar)

An implantable port or 'Portacath' is an implanted device which is fixed under the skin, usually on either the chest wall or forearm and is accessed using a hollow needle. The device has a reservoir that is connected to a catheter that leads into a central vein in the body. The reservoir of the device is covered with a self-sealing silicone and in order to access the reservoir of the device, and therefore the blood supply, a needle must be inserted through this silicone and fixed in place. When the port is not in use, the needle is removed and the child is able to maintain a more normal life (including going swimming) with a greatly reduced chance of infection, compared to with other CVADs.

As with tunnelled CVADs, these implanted ports are tunnelled from the port site, usually on the chest, up to the neck, where a small incision is made and the catheter is inserted into the superior vena cava (Children's Cancer and Leukamia Group, (CCLG), 2020). Though it is possible to get double ported implantable ports, which have separate lines to enable separate usages and require accessing with two needles, a single port is the most commonly used.

Peripherally Inserted Central Catheters (PICC)



(Please redraw picture of PICC line or similar)

Peripherally Inserted Central Catheters (PICC) are usually tunnelled from the cephalic, median cubital or basilic vein in the anticubital region of the arm into the superior vena cava (CCLG, 2020). PICCs can also have numerous lumens if required in order to facilitate multiple usages. Though the length of time a PICC can be inserted varies, their recommended usage is usually around six weeks. This therefore makes this CVAD useful for children who may require central venous access for an intermittent period such as 6 weeks of IV antibiotic treatment or temporary nutritional support from TPN.

Table 1. Commonly used CVADs in Children

Central Venous Access Device	**Common uses**	**Advantages**	**Disadvantages**
Tunnelled CVAD	-Longer term care of chronically unwell children, i.e. cancer - Useful for delivery of IV medications and TPN	-Immediate access to central blood supply -Longer term use -No needles required	-More difficult insertion due to need for tunnelling -Higher risk of infection
None-Tunnelled CVADs	-Emergency care of acutely unwell children -Central venous pressure monitoring	-Immediate access to central blood supply -Easier insertion -No needles required	-Shorter term use -Higher risk of infection
Implantable Port	Longer term care of chronically unwell children, who may need less frequent treatment, i.e.	-Lower risk of infection -Longer term use	-Requires needle access

	Cystic Fibrosis, Cancer - Useful for delivery of intermittent IV medications and TPN		
Peripherally Inserted Central Catheter (PICC)	-Medium term treatment as a one off, i.e. long term IV antibiotics, Cancer	-Lower risk of infection -No needles required	-More difficult insertion due to need for tunnelling -Often smaller in size due to limitations of smaller veins in arm -Increased risk of becoming dislodged

How to access and care for a CVAD

All healthcare professionals, parents and carers who access and care for CVADs in children need to have undertaken relevant training and had practical supervision before they are deemed competent in the use of CVADs (GAIN, 2014). When accessing or caring for a CVAD, it is essential that Aseptic Non-Touch Technique (ANTT) is used in order to prevent infection (GAIN, 2014). Though the below is a useful guide, it is important that the healthcare professional follows local guidance for use of ANTT as this may vary across healthcare settings.

Accessing an Implantable Port with a non-coring safety needle (GAIN, 2014).

Step 1

Local anaesthetic cream may be applied under aseptic conditions before accessing the device. This should be removed after the appropriate amount of time.

Step 2

Prepare equipment, choosing an appropriate length of needle which is selected depending on the amount of subcutaneous tissue over the port and the depth of the reservoir.

Step 3

Hand cleaning should be carried out using the correct hand hygiene technique using either alcohol hand rub for 20-30 seconds or soap and water for 40-60 seconds.

Step 4

Under aseptic conditions, disinfect the skin around the Implantable Port site with 2% chlorhexidine and 70% isopropyl alcohol (NICE, 2014; Loveday et al, 2014). Allow the solution to dry.

Step 5

Insert the needle through the skin and septum, into the reservoir of the Implantable Port, ensuring the needle hits the back plate and sits flush against the skins surface.

Step 6

Ensure the correct placement of the needle through the aspiration of blood.

Step 7

Flush and lock the CVAD as described in table 1.

Step 8

Secure the needle with a sterile, transparent, semi-permeable dressing.

Accessing a CVAD (for the purpose of flushing the device) (GAIN, 2014).

Step 1

Hand cleaning should be carried out using the correct hand hygiene technique using either alcohol hand rub for 20-30 seconds or soap and water for 40-60 seconds.

Step 2

The hub of the CVAD should be disinfected with an alcoholic chlorhexidine gluconate solution, usually a 2% chlorhexidine gluconate in 70% isopropyl alcohol wipe, and left to dry for 15 seconds (NICE, 2014; Loveday et al, 2014).

Step 3

Syringes to be connected to CVAD should preferably be 10ml in size to avoid high pressure causing the catheter to rupture and use a male/female luer lock. Once the syringe is connected, undo the clamp on the CVAD.

Step 4

Flush with the amount of sodium chloride 0.9% appropriate to the catheter in use as described in table 1, using a brisk push-pause or pulsating method to prevent reflux of blood. If appropriate, lock the line as described in table 1.

Important note: Before flushing an implantable port device, it is necessary to obtain a flashback of blood to ascertain that the needle has not become dislodged.

Step 5

Once the line is flushed/locked, clamp the line in the specially reinforced area of the CVAD to prevent air entry and bleeding in the case of the luer lock cap becoming damaged or detached from the CVAD.

Important note: If the CVAD has more than one lumen, each lumen should be accessed and flushed individually.

Table 1 (GAIN, 2014, p20). There may be local variances to this guidance.

CVAD Type	Intermittent Drug Administration within a 24 hour period	Intermittent Blood Sampling	Not in use
Short term CVC in acute care setting.	Flush with at least 1ml Sodium Chloride 0.9% injection before drug and up to 3ml Sodium	Flush with 1ml Sodium Chloride 0.9% injection after blood sample, followed by Heparin Sodium	Flush daily with 1ml Sodium Chloride 0.9% injection followed by 2ml Heparin Sodium

	Chloride 0.9% injection after drug.	Flushing Solution 10 units/ml.	Flushing Solution 10 units/ml.
Peripherally Inserted Central Catheter	Flush with at least 1ml Sodium Chloride 0.9% injection before drug and up to 3ml Sodium Chloride 0.9% injection after drug.	Flush with 1ml Sodium Chloride 0.9% injection after blood sample, followed by Heparin Sodium Flushing Solution 10 units/ml.	Flush on alternate days with 1ml Sodium Chloride 0.9% injection followed by 2ml Heparin Sodium Flushing Solution 10 units/ml.
Tunnelled Central Venous Catheter	Flush with Sodium Chloride 0.9% injection before drug and after drug administration. Draw up to 3.5ml Sodium Chloride 0.9% and inject 3ml.	Flush with 2ml Sodium Chloride 0.9% injection after blood sample, then flush with Heparin Sodium Flushing Solution 10 units/ml. Draw up 2.5ml Heparin Sodium Flushing Solution 10 units/ml and inject 2ml.	Flush once or twice weekly. Draw up 2.5ml Heparin Sodium Flushing Solution 10 units/ml and inject 2ml.
Implanted Port	Ensure flashback of blood. Flush with up to 3ml Sodium Chloride 0.9% injection before drug and after each drug and lock with 2ml Heparin Sodium Flushing Solution 10 units/ml.	**For administration of drugs or blood sampling daily or less frequently:** Prior to flushing, ensure 4ml of blood is discarded to remove heparinised saline. Flush with 10ml Sodium Chloride 0.9% injection and clamp the line. Lock with 4ml Heparin Sodium Flushing Solution 100 units/ml.	Flush monthly. Prior to flushing, ensure 4ml of blood is discarded to remove heparinised saline. Flush with 10ml Sodium Chloride 0.9% injection and clamp the line. Lock with 4ml Heparin Sodium Flushing Solution 100 units/ml.

Care of dressings on a CVAD device (GAIN, 2014)

Healthcare professionals should always follow local guidelines as these may vary in dressing choice and use of ANTT. CVAD devices should be dressed by placing a sterile, transparent, semi-permeable polyurethane dressing over the insertion site. Dressings that are clean, dry and intact can be changed every 7 days but any dressings which become compromised may need to be changed more frequently.

Step 1

Apply gloves and remove the old dressing from the CVAD.

Step 2

Hand cleaning should be carried out using the correct hand hygiene technique using either alcohol hand rub for 20-30 seconds or soap and water for 40-60 seconds.

Step 3

Disinfect the insertion site using 2% chlorhexidine and 70% isopropyl alcohol and allow to dry (NICE, 2014; Loveday et al, 2014).

Step 4

Apply a new sterile, transparent, semi-permeable polyurethane dressing over the insertion site ensuring that the dressing fully covers the insertion site and is well adhered to the patient's skin.

Daily Care of a CVAD device (GAIN, 2014)

All children with a CVAD are at increased risk of infection and as such require close monitoring. Daily care of a child with a CVAD should include a daily visual inspection of the insertion site of the CVAD to look for signs of redness, swelling or pus formation. Children with tunnelled CVADs may also be monitored to look for signs of redness tracking along the tunnelling of the CVAD.

When a CVAD is in use, children should also be monitored for signs of infiltration and extravasation at the exit site and along the tunnelling of the CVAD. Infiltration is the administration of non-vesicant fluids outside of the vein and extravasation is the administration of vesicant fluids which may cause vein damage and rupture (Tofani et al, 2012). Signs of infiltration or extravasation include swelling, pain and redness, and a Visual Infusion Phlebitis (VIP) score is usually recommended throughout boluses and short infusions, and hourly when the line is in continuous use.

Clinical considerations

Routine Use of Heparin locks

Though local guidance may vary, the Regional Medicines Optimisation Committee (RMOC, 2019) recommends that there is no need to routinely use heparinised saline lock for the purpose of maintaining the patency of a central venous catheter (CVC). There is an associated number of disadvantages to the routine use of heparinised saline which includes and increased demand on aseptic services and the exposure of patients to an active medicine that could cause side effects (RMOC, 2019).

Aspirating CVADs in Children

Though local policies may vary, and past evidence has argued that there is benefit to aspirating all CVADs before use to reduce the risk of pulmonary emboli (Coulthard and Skinner, 2007), the GAIN (2014) guidance does not advocate the routine aspiration of standard paediatric CVADs before each use. It is necessary, however, to aspirate and discard a small volume of blood prior to taking a blood sample to ensure the accuracy of the blood sample. GAIN guidelines (2014) do not specify what volume of blood should be discarded, so healthcare professionals should refer to their local policies, however, research has shown that a volume of discard of 3mls was demonstrated to be sufficient to ensure a valid blood sample (Cole et al, 2007).

Potential problems in CVADs in Children

There are numerous complications which can occur when a child has a CVAD and prompt recognition and treatment of these is key. Table 2 highlights some potential problems, how to recognise these and the necessary treatment. Healthcare professionals should always refer to their local guidelines for best practice for their area.

Complication	Signs and Symptoms	Treatment
Infection	High temperature	Swab any pus

	Redness, swelling or pus formation around the insertion site Redness tracking along the tunnel of CVAD Pain in the insertion site or surrounding tissue (GAIN, 2014)	Blood cultures from the port and from a peripheral vein (if possible) IV antibiotics according to local antimicrobial prescribing guidelines (GAIN, 2014).
Cut or break in line	Leakage of blood or fluids when flushing through a tear or hole in the line.	If possible, move clamp to above break in line and clamp. If this is not possible then apply sterile gauze to the area and seek further assistance. Breaks in CVAD lines can sometimes be repaired but on occasion may need to be replaced (Zens et al, 2019).
Line falls out	Line is either fully or partially out of place Blood loss from insertion site	Apply sterile gauze and pressure over the insertion site Seek urgent surgical review
Blocked line	Increasing pressure when flushing line Unable to flush line	Local guidelines may vary but thrombolytic therapy such as alteplase can be used. Surgical intervention may be required (Baskin et al, 2009).
Unable to obtain aspirate from line	Resistance when trying to aspirate CVAD.	Treatment may vary depending on the type of CVAD. Local guidelines may vary but thrombolytic therapy such as alteplase could be used. Patients should be observed for discomfort on flushing and oedema at the line site. In Implanted Ports a change of needle may resolve the issue. Refer to local guidelines.
Thrombosis	Oedema of the face, neck, arms or shoulders Venous distension/collateral circulation Pain, aching or tenderness of the chest, shoulder or arm Numbness or tingling of the fingers, hands or arms Skin discolouration, particularly of the arms and hands (GAIN, 2014)	Further blood testing and Ultra Sound Scans will be required but treatment is likely to be pharmacological with heparin (NICE, 2015a).

Reassurance during CVAD access and care

Having a CVAD inserted and used can be a source of physical and mental distress for children and young people. Depending on the CVAD in place, there is a risk of pain, altered body image, needle phobia and long term complications. Children's nurses caring for children with CVADs need to use their communication skills to explain the needs for the CVAD and distraction techniques to support the child and family. 'Using play as a distraction technique for children undergoing medical procedures' is a companion article in this 'at a glance' series which offers vital information on the use of distraction in children's nursing (Drape and Greenshields, 2020).

Antimicrobial use in Children with CVADs

There is a growing body of knowledge which suggests that the use of an antimicrobial agent, specifically Octenisan in paediatrics, is beneficial for skin decolonisation prior to CVAD insertion (Hübner, Siebert & Kramer, 2010; Guys & St Thomas' NHS Foundation Trust, 2017). Healthcare professionals should follow local guidelines on the use of antimicrobials, but it is often indicated that children be washed using Octenisan for 1 week before a CVAD insertion and then 5 days per week for the duration of line insertion.

Due to the need for antimicrobial stewardship in the NHS, to ensure that healthcare professionals reduce the unnecessary use and prescriptions of antimicrobials, the use of antimicrobial medications in children with CVADs should be closely monitored (DH, 2019b). Following NICE guidance (2015), healthcare professionals must prescribe the shortest effective course of antimicrobials where needed and ensure that the most appropriate dose of antimicrobials is used. All healthcare professionals have a role to play in monitoring the use of antimicrobials in children with CVADs but it is the responsibility of specific antimicrobial stewardship teams to review prescribing of antimicrobials (NICE, 2015). Antibiotic locks should not routinely be used to prevent CVAD related bloodstream infections (NICE, 2017).

Recommended Reading

- Guidelines and Audit Implementation Network (GAIN): Guidelines for Insertion and Maintenance of Central Venous Access Devices in Children and Young People (2014).
- National Institute of Health and Care Excellence (NICE): Healthcare-associated infections: prevention and control in primary and community care (2017).
- National Institute of Health and Care Excellence (NICE): Antimicrobial stewardship: systems and processes for effective antimicrobial medicine use (2015b).
- Aseptic Non Touch Technique (ANTT) web resource available from http://www.antt.org/ANTT_Site/about.html.

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