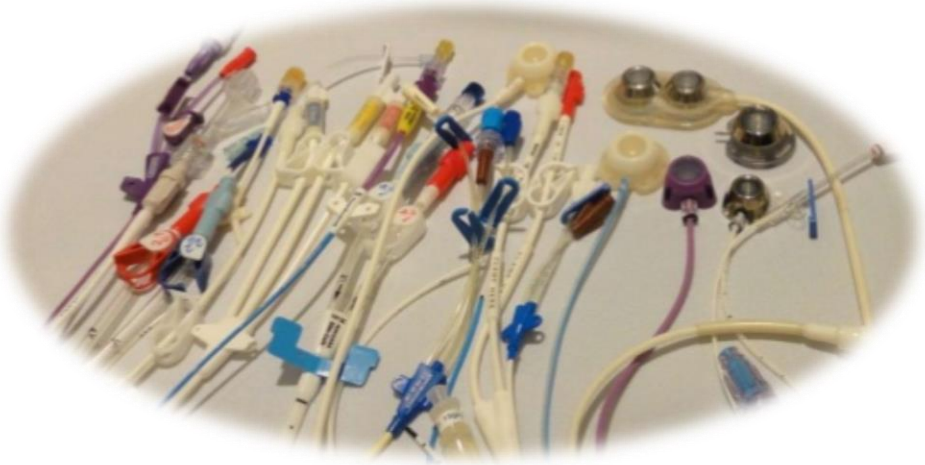
Canterbury
District Health Board
Te Poari Hauora ō Waitaha

CENTRAL VENOUS ACCESS DEVICES

Resource Book



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INTRODUCTION

Central venous access devices (CVADs) are catheters inserted into peripheral upper arm veins or central veins in the chest, neck or groin, which pass along the venous pathway with the distal tip positioned at the cavoatrial junction (considered to have the greatest safety profile). The catheter tip for CVADs inserted into the femoral vein is the inferior vena cava, above the level of the diaphragm. CVADs provide reliable access to the venous system, are suitable for the administration of peripherally incompatible solutions, enable multiple or high-volume infusions of solutions and reduce the need for peripheral blood sampling. CVADs may have single or multiple lumens, be power-injectable or standard, trimmed or non-trimmed, tunneled or non-tunneled. (Gorski, L. A., L. Hadaway, M. E. Hagle, et al. 2021).

Long-term CVADs may be in situ for months to years and do not develop complications. Common types of long-term CVADs are Hickman® catheters, tunneled cuffed centrally inserted central catheters (CICCs) and totally implantable venous access devices (TIVAD/Ports). These devices can be standard or power-injectable, single or multiple lumen (or double TIVAD). However, it should be recognized that CVADs are not without risk. All types of IV catheters are associated with catheter related blood stream infection (CR-BSI). CVADs have a higher rate of CR-BSI than peripheral IV catheters, therefore interventions to reduce the rate of CR-BSI are especially important for their management and care (Maki, et. al, 2006).

The NZ Auditor-General's Report**,** *Management of Hospital Acquired Infections (2003 Vol: 1&2 p.27-28)* 'one in 10 patients admitted to hospital will acquire an infection because of their hospital stays'. The rate may well be higher due to under reporting (p.271.21). Blood stream infections comprise greater than 10% of Healthcare Associated Infection (HAI) and can have very high mortality rates, higher than 30%. Patients with Healthcare Acquired Blood Stream Infections (HABSI) stay longer in hospital incurring additional cost to treat. Almost 80% of HABSI occurred in six large District Health Boards with complex services at an estimated cost of $19 million each year (NZ Auditor - General's Report, 2003).

CVAD complications range from mild local irritation to serious life-threatening events. Blood stream infections are associated with significant mortality and morbidity. It is imperative that healthcare professionals involved in the care of CVADs are competent to do so, because practice vigilance is critical in reducing and preventing complications (Robert, et al., 2000, Infusion Therapy Standards of Practice 2021).).

The excess cost associated with healthcare-associated bloodstream infections at Auckland City Hospital is described by Burns A, Bowers L, Pak N, et al. in the N Z Med J. 2010;123:17-24

The CDC-Guidelines for the Prevention of Intravascular Catheter–Related Infections *Vol:51 No RR-10 2011**,** (p5)* 'inexperienced staff increase the risk for catheter colonization where as well organised Quality Assurance and Continuing Education programmes enable health-care institutions to provide, monitor and evaluate care and to become educated for successful outcomes**.** Specialised teams have shown unequivocal effectiveness in reducing the incidence of CRI and complication'.

PROFESSIONAL ACCOUNTABILITY

Registered Nurses must meet the standards outlined in the Competencies for entry to the Register of Comprehensive Nurses (Nursing Council of NZ 2002) and Midwives (NZ Midwifery Council) this applies to all nurses and midwives currently practicing**.**

Competence is the combination of skills, knowledge, attitudes, values and abilities that underpin effective performance as a nurse (NZNC, 2003).

Ongoing competency assessment and documentation is a continuous process driven by patient and organizational outcomes. As members of the health care team RNs must collaborate to achieve the universal goal of safe, effective, and appropriate infusion therapy. (Infusion Therapy Standards of Practice 2021)

Professional accountability is established through:

1. Demonstrating a level of practice and professional accountability, appropriate to level of skills
2. Having a sound knowledge of the management and care of CVADs
3. Having knowledge of medication and IV fluid treatment modalities
4. Performing accurate assessment through identifying catheter specific indications, contraindications and associated risks
5. Utilising critical thinking skills and evidence based practice to achieve best patient outcomes
6. Confidently articulating scope of practice, identifying and acknowledging limitations and seeking assistance appropriately
7. Patient engagement and education

CENTRAL VENOUS ACCESS DEVICE ENDORSEMENT

The CDHB Central Venous Access Device (CVAD) endorsement requires *Re-validation* three (3) yearly. This involves completing both the healthLearn modules and practical skills assessment. The prerequisite is Intravenous Therapy Endorsement or Medication and Fluid Foundation Programme level 3

Components of CVAD Endorsement and Re-validation:

1. Theory
2. Practical Skills Assessment:
    - Non-implanted Devices - PICC, CVC, Tunneled catheters (Hickman®, CICC, TFIC)
    - NB: Dialysis and apheresis catheters are managed by their respective specialties
    - Implanted Devices – standard and power injectable Port if require in area of practice

Follow the Instructions for CVAD Endorsement on the healthLearn site

1. Review the CVAD Resource Book, healthLearn education resources and practice videos.

2. Complete Multi-choice Theory Modules for non-implanted or implanted devices as applicable. The answers can be found in the CVAD Resource Book and the online education resources. 100% pass mark is required.

3. Print off the Practical Skills Assessment Form and complete within 8 weeks of completing the theory test with a current CVAD endorsed IV Link Staff (RN, RM,)

4. Complete the course evaluation then print off the Certificate of Theory Completion

5. Return the completed Practical Skills Assessment Form to PDU. On completion of this process you will receive 8 hours towards professional development.

Non-Implanted Devices: On completion, the results will be uploaded onto your healthLearn *'Record of Learning'*. You are then endorsed to manage the following devices:

- PICC
- CVC
- Tunnelled catheters (Hickman®, CICC, TFICC. (Dialysis/apheresis catheters are only to be used by their respective specialty staff)

Implanted Devices: is a separate endorsement. The pre-requisite is a non-implanted device endorsement. On completion, the results will be uploaded onto healthLearn

NB. Nurses with an Implanted Port endorsement are permitted to access (insert the needle) and de-access (remove the needle) from a port. Once the needle with extension set has been inserted, nurses with non-implanted device CVAD endorsement can use the implanted port to deliver IV medications/infusions /blood sampling.

Refer to the implanted port section in this document to guide you.

LEARNING OBJECTIVES

This comprehensive resource book is designed to assist Medical, Nursing and Midwifery clinical staff develop critical thinking skills to demonstrate knowledge in assessment, management, maintenance and care of Central Venous Access Devices (CVAD).

- Identify the type and definition of CVADs
- Understand the anatomy and physiology of blood flow in relation to CVADs
- Understand the differences between each device
- Understand the principles of infection prevention and control
- Identify complications and describe prevention and management
- Understand the action of medications and drug precipitates
- Accurately document catheter and patient assessment
- Understand the importance of patient education and engagement
- Identify catheter considerations when administering Parenteral Nutrition (PN)
- Identify key differences in caring for a child or infant with a CVAD

Throughout this package are Alerts, Actions and Further Reading

 This symbol indicates 'important alerts'

ACTION This symbol indicates 'important actions'

 This symbol indicates 'for further reading'

 Child Health considerations for CVADs is included throughout this resource.

CHILD HEALTH CONSIDERATIONS

Many children experience a range of emotions at the prospect of a nurse carrying out a procedure on their CVAD. Children might be distressed by dressing removal, cleaning around the insertion site and needle access. It is important for the nurse to understand that:

- younger children may see the intervention as punishment [1]
- the language used to explain and prepare the child needs to be developmentally appropriate
- parents also need to be involved and prepared for the procedure
- children sometimes move unexpectedly during procedures- more than one nurse will usually be required to help with the procedure
- children with chronic illnesses may become particularly sensitised to painful procedure [2]– they don't just get used to it
- coping is increased by enabling children to have a degree of control during the procedure (e.g. holding the blood tube)

Preparation

- CVAD procedures are usually carried out in the treatment room because the child's bed is considered to be a 'safe' place
- Always explain to parents and caregivers what the procedure will involve. The parents or caregivers should not be used to restrain the child or be an extra pair of hands. Their role is to support their child
- Hospital Play Specialists should be involved (distraction, support of the child and therapeutic play) whenever possible and this is best achieved with prior organisation
- All equipment should be prepared before the child is brought to the treatment room
- Avoid unnecessary delays

Paediatric PICC Migration Action Chart. **SEE PAGE 56**

Associated Reading

- Restraint minimisation, Child Health E-guidelines
- [1] Twycross, A., Dowden, S., Bruce, E., (2009). *Managing Pain in Children: A Clinical Guide*. Blackwell Publishing LTD. United Kingdom.[2] Lawes,C.,Sawyer,L.,Amos,S.,Kanddiah,M.,Pearce,L.,Symons,I.(2008).Impact of an education programme for staff working with children undergoing painful procedures. *Paediatric Nursing.20(2) p33-37*

DEFINITION OF CENTRAL VENOUS ACCESS DEVICES

Central venous access devices (CVADs) or central venous catheters (CVCs) are catheters that are inserted through a vein to enable the administration into the bloodstream of IV fluids, blood products, medication and other therapies. CVADs can be inserted into the subclavian or jugular vein or can be inserted into one of the peripheral veins of the upper extremities, called peripherally inserted central catheters (PICCs).

The tip location with greatest safety profile is the cavo-atrial junction (CAJ) *(Infusion Therapy Standards of Practice 2021).*

Although there are many veins in the body only a few are suitable for insertion of CVAD.

The most commonly used insertion sites are (see Figure 1):

- Neck (internal jugular vein)
- Upper chest (subclavian vein)
- Mid upper arm (basilic vein)
- Femoral *(access to Inferior Vena cava – not consider a centrally placed catheter)*

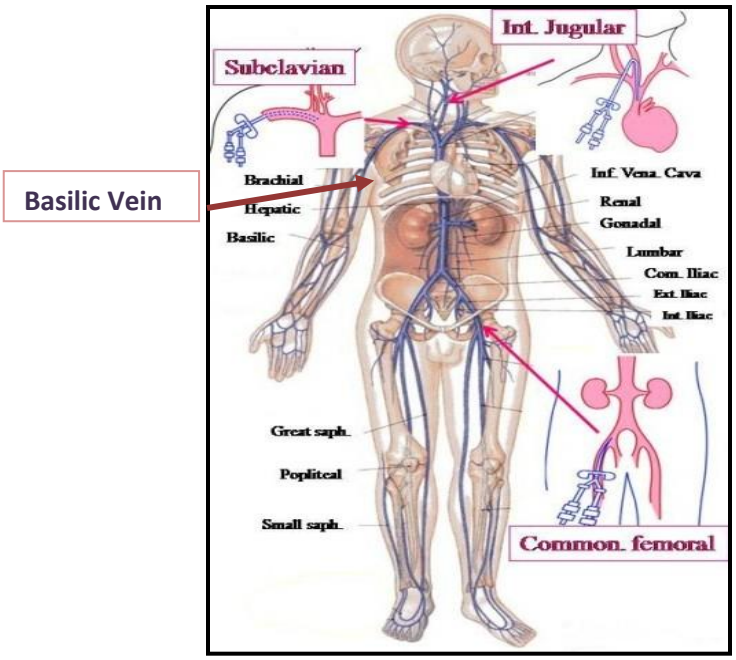


Fig.1: Commonly used insertion sites Source: unknown

Additional IV Therapies include:

- Vesicant and irritant medications and solutions e.g. cytotoxic/biotherapy or antibiotics
- Complex drug therapy regimes
- Rapid hydration of fluid or blood /blood products
- Parenteral Nutrition (PN)
- Blood sampling
- Therapeutic procedures (TPEX, Dialysis, Peripheral blood stem cell harvest)
- Compromised venous access
- CVP monitoring

Tip position of a CVAD must be radiologically verified prior to use

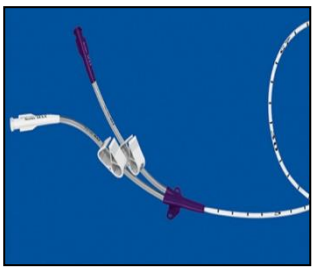
CVADs come in different lengths and gauge sizes and be either single or multiple lumen. Multiple lumens provide independent access to the venous circulation. This allows two or more incompatible drugs or fluids to be infused simultaneously. As a general principle, the lumen diameter and number of lumens should be kept to a minimum as multiple lumen large bore catheters are associated with a higher risk of infection and thrombosis (Simcock, 2001., INS An evidence-based approach 2010, Vessel Health Preservation, 2020). However, in the high dependency settings, multiple lumen large bore catheters tend to be used because they are essential for management of acutely ill patients.

The following CVADs are used within the Canterbury District Health Board (refer Figure 2):

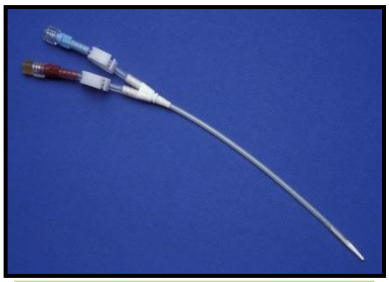
- Peripherally Inserted Central Catheter (PICC)
- Skin tunnelled catheters (Hickman®, CICC, TPICC, TFIC (tunneled femoral inserted catheter)
- Non-tunnelled Central Venous Catheter (*CVC)*
- Implanted ports (chest and arm, standard and power injectable)
- Dialysis & Apheresis catheters which are therapeutic procedure specific

Power Injectable – PI*

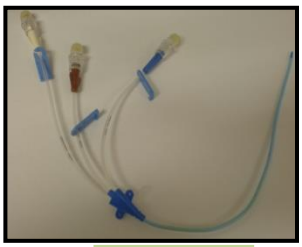
*Information regarding the management and care these catheters can be found in the section on '**Catheter Specific Information'.***



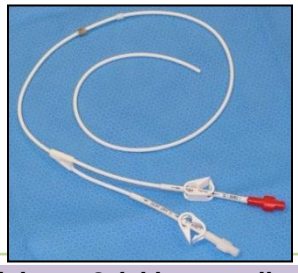
PICC/TFIC PI



Dialysis / Apheresis PI



CVC PI



Hickman® (skin tunnelled)

Chest Inserted Central Catheter CICC PI
(skin tunnelled)

Implanted port PI

Fig.2: CVAD used in the CDHB Source: Original Photo

ADDITIONAL CATHETER INFORMATION:

Apheresis Catheter (hard wall): Is used for therapeutic procedures such as plasma exchange or Peripheral Blood Stem Cell Harvesting. These are for short- or long-term access and are used by the NZ Blood Service Apheresis Nurses only.

NOT TO BE ACCESSED by unauthorized staff.

Dialysis Catheter: Is used for the Haemodialysis of renal patients. These are accessed and maintained by the dialysis technicians and dialysis / renal nurses and ICU only.

NOT TO BE ACCESSED BY unauthorized staff.

Groshong® Tunnelled Valved Catheter: Is a device used in Haemotology patients at Auckland Hospital. Occasionally these patients are transferred to Christchurch Hospital to continue their treatment and will present with this catheter in situ.

For further information on all types of CVAD please refer to the Catheter Specific Section

DEPARTMENTS RESPONSIBLE FOR INSERTION OF CVAD

 Insertion of all CVADs is carried out under Maximal Sterile Barrier (MSB) conditions

PICCs:

Inserted in the Interventional Radiology department by credentialed vascular access nurses

Tunnelled catheters:

1. **Hickman®.** Inserted in the Interventional Radiology department using an image intensifier by the Interventional Radiologist (adults & adolescence) and occasionally in Operating Theatre (Paediatrics)
2. **Chest Inserted Central Catheters (CICC)** Inserted in Interventional Radiology by advanced credentialed vascular access nurses
3. **Tunneled non-cuffed TPICCs & TFICC** Inserted in Interventional Radiology by advanced credentialed vascular access nurses
4. **Tunneled Dialysis/Apheresis catheters**: Inserted in the Radiology Department using an image intensifier by the Interventional Radiologist

Implanted Ports

Inserted in Operating Theatre by a Vascular Surgeon, Interventional Radiologist or Paediatric Surgeon

Non- tunnelled CVC

Inserted in Operating Theatre, ICU, Anesthetist's, Emergency Department

Catheter to vein ration plays an important role in reducing complications such as thrombosis.
The best patient outcome is the successful use of a minimal number of vascular access devices to administer the complete therapy with minimal complications

DEVICE SELECTION ALGORITHM

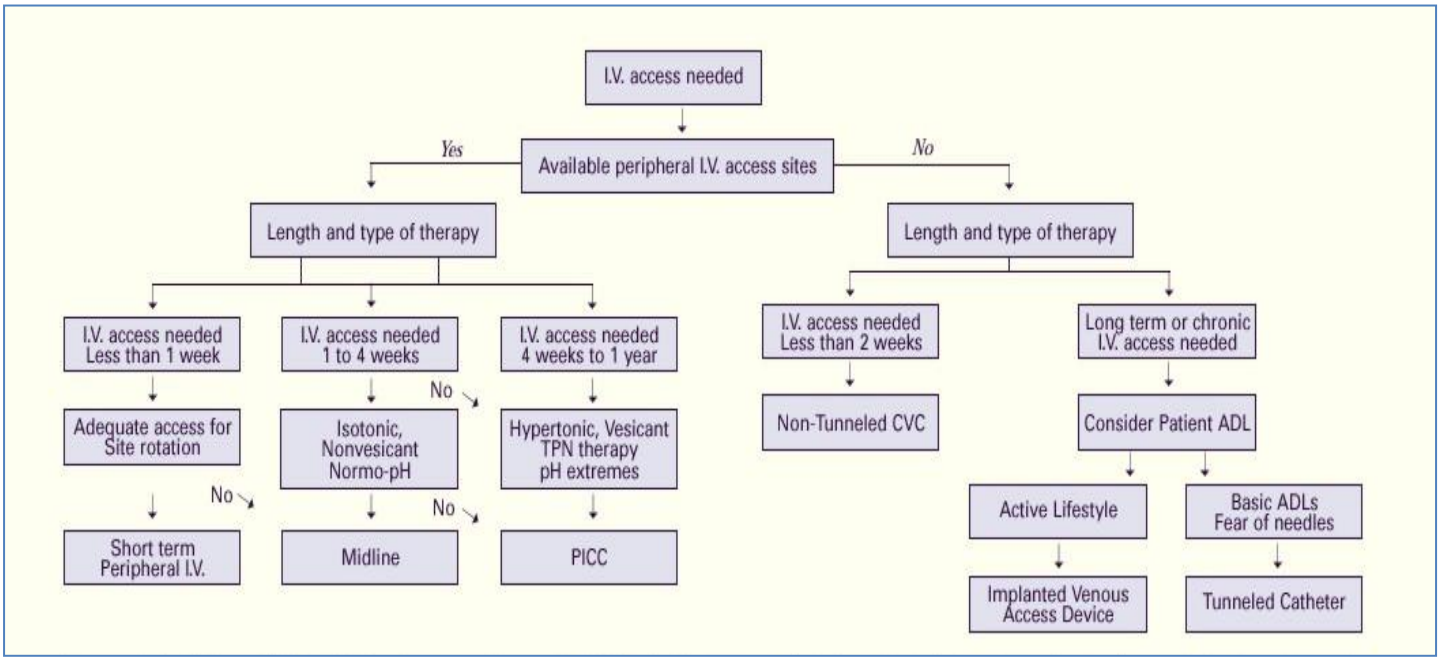


Fig.3: Device Selection Algorithm

Source: Johnson and Johnson Medical

Table 1: Equivalent Gauge and French size

Equivalent Gauge and French sizes of vascular access devices	
Gauge (G)	**French (Fr)**
23 g	2.0 fr
20 g	3.0 fr
18 g	4.0 fr
16 g	5.0 fr
11 g	9.0 fr
10 g	10.0 fr
7 g	13.0 fr

Source: Gabriel J et al (2005)

CATHETER MATERIAL IS EITHER SILICONE OR POLYURETHANE

Silicone: Is soft, pliant, resistant to many chemicals such as ethanol, is less thrombo-resistant, has poor tolerance to pressure (ruptures easily) and drugs can leach into material

Polyurethane: Has good tensile strength, is generally kink resistant, softens in the vein, is thrombo-resistant, has higher flow rates and a high degree of biocompatibility. ***Ethanol locks are unsuitable for use in catheters made of polyurethane.***

Knowledge of anatomy, physiology and the principles of blood flow are essential for safe management of all Central Venous Access Devices.

Figure 4 below shows the major veins of the central vasculature where CVADs are placed.

CVADs can become displaced although displacement is more likely to be seen with a PICC. This is due in part to the insertion site in the upper arm and a smaller diameter compared to larger catheters. Tip migration or malposition may occur most commonly, but not restricted, the following veins:

- Internal jugular
- Contralateral brachiocephalic (opposite to the vein the catheter has been inserted into)
- Azygos

Action: Locate the 3 veins above on the diagram below

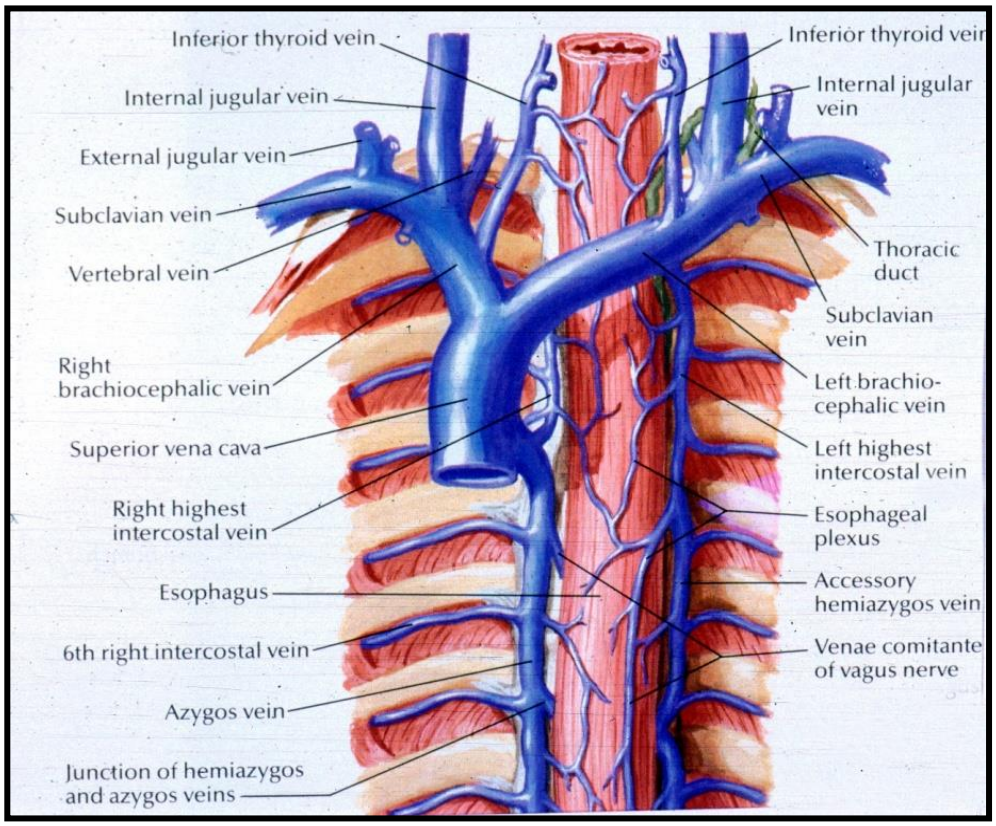


Fig.4: **Major Central Veins** Source: Medical Illustrations, Christchurch Hospital

Veins and Valves

Veins are known as reservoir vessels with approximately 65% of blood volume found in the venous circulation system. (Refer to figure 5). The vein walls distend six to ten times more than arterial walls with only the smallest amount of pressure. This means that normal pressure is re-established quickly, for example following the release of a tourniquet. This is referred to as a 'Stress Relaxation Phenomena'.

The veins also rely on what is referred to as a muscle or venous pump. When muscles contract they compress the vein. This helps return blood to the heart. When a muscle contracts, proximal valves open while distal valves close. This action can specifically affect the PICC causing it to migrate either in or out of its correct tip position if it is not well secured e.g. a subcutaneous stabilization device (SecurAcath™)

Muscle action can initiate blood reflux into the tip of a catheter. Pressure from the contracting muscle forces the 'locking fluid' out of the catheter lumen allowing blood to reflux into the catheter when the muscle relaxes. The vein and catheter are two distinct flow systems, each vulnerable to occlusion (Hadaway, 2005).

Valves are structures within the lumen of the vein. These are formed by the endothelial lining of the Tunica Intima. They are present as bumps usually found at vein bifurcations and predominantly found in large veins of the extremities (refer to figure 6). There are approximately 40 venous valves between the hand and the axillary vein. Larger veins of the central vasculature do not have valves

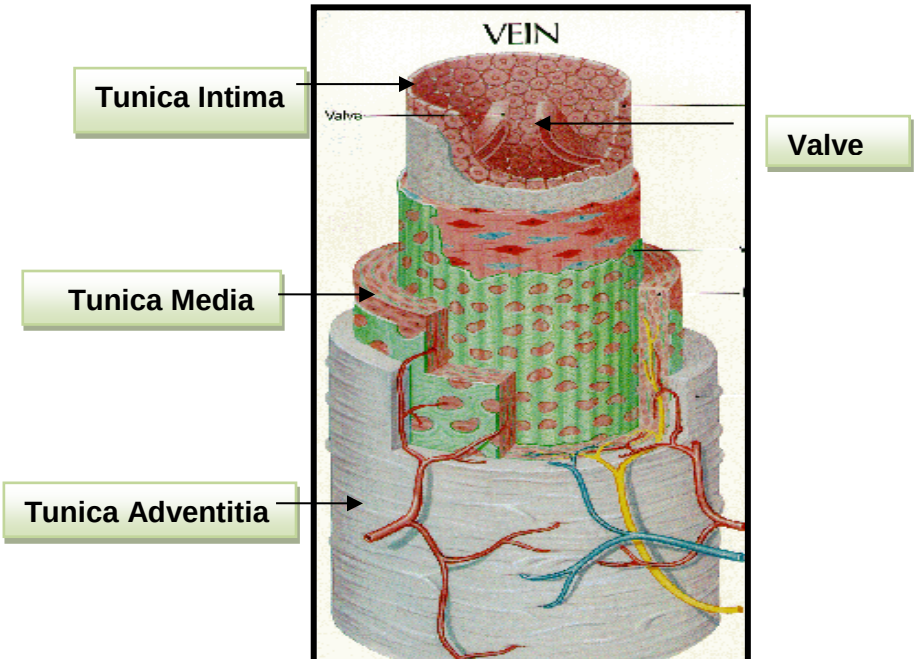


Fig.5: Veins Source: Johnson and Johnson Medical

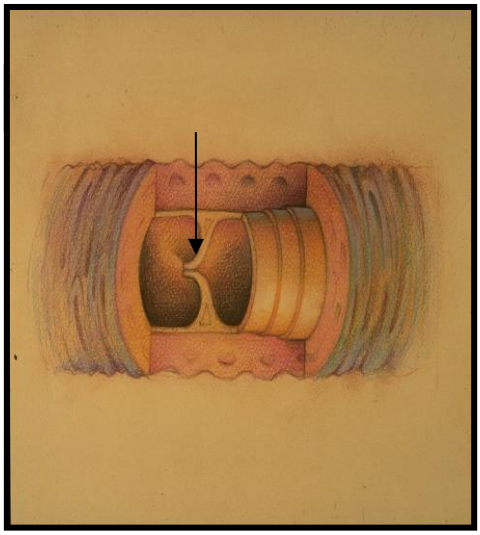


Fig.6: Venous valve Source: BD Medical Systems

1. The Tunica Intima is the delicate inner lining of the vein. This can become damaged by mechanical, chemical or bacterial means. The damage causes, bleeding into the interstitial compartments of the basement membrane.

2. The Tunica Media has muscle and connective tissue which forms the bulk of the vein.

3. The Tunic Adventitia, rich in nerves provides the pain pathway.

4. All three layers can be affected giving rise to phlebitis. PICCs are more likely to be affected due to a high potential for movement if there is not effective catheter securement. In addition to this a portion of the catheter lies in a smaller peripheral vein in the upper arm.

PHYSIOLOGY OF THE INFLAMMATORY PROCESS

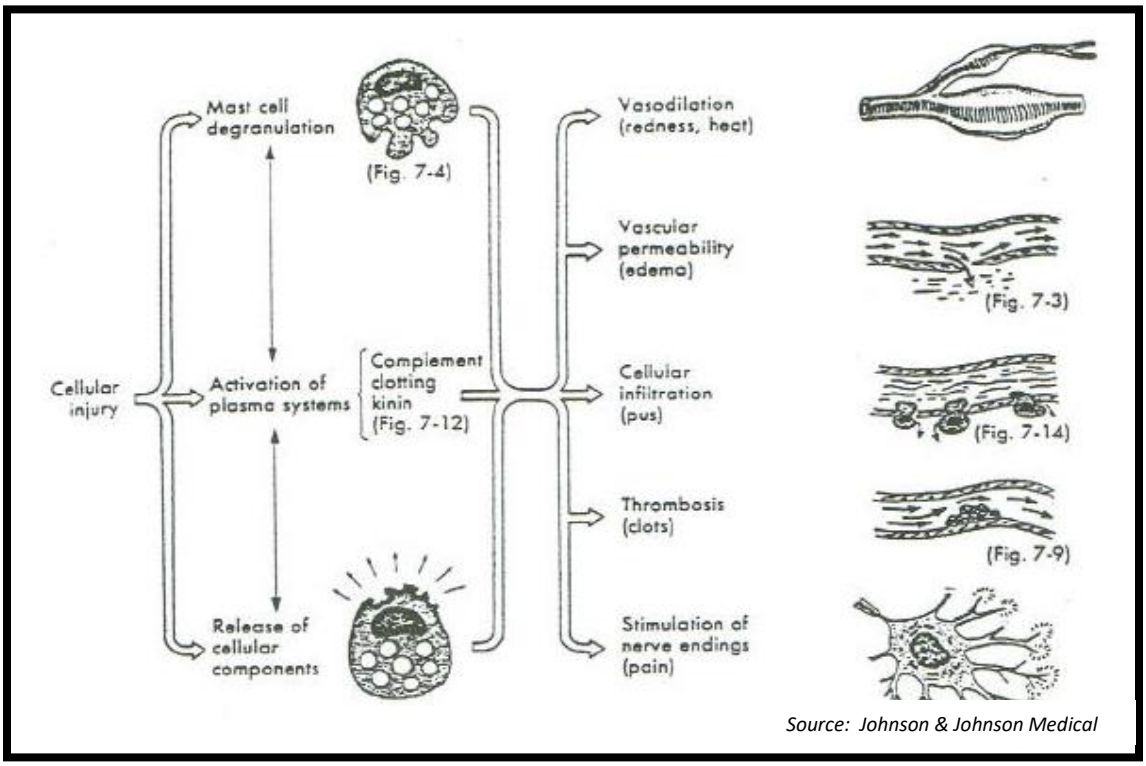


Fig. 7: Inflammatory Process

Phlebitis is the result of an inflammatory process in of the intima of the vein due to irritation to the endothelial cells (refer figure 7). It is classified according to its causative factors. The four causative factors are:

- chemical
- mechanical
- bacterial
- post infusion

PHYSIOLOGY OF BLOOD and BLOOD FLOW RATES

CVADs are inserted into an appropriate vein and advanced along the vein pathway until the catheter tip reaches its destination at the cavoatrial junction (CAJ). On average the blood flow at this point is approximately 2000 mL/min which is far greater than in a peripheral vein (refer to table 2).

This means that irritant drugs and fluids with concentrations of solutions with extremes of pH or osmolality can be infused without damaging the vessel wall due to this increased haemodilution.

Blood comprises:

- Viscosity
- Osmolality
- pH
- Coagulation

Table 2: Vein flow rates

VEIN	DIAMETER	FLOW RATE	LENGTH
Cephalic	**6 mm**	**40-60 mL/min**	**38 cm**
Basilic	**8 mm**	**60-95 mL/min**	**24 cm**
Axillary	**16 mm**		**13 cm**
Subclavian	**19 mm**	**150 mL/min**	**2.5 cm**
Innominate	**19 mm**	**800 mL/min**	**6 cm**
Superior Vena Cava	**20 mm**	**2000 mL/min**	**7cm**

The tip location with greatest safety profile is the cavo-atrial junction (CAJ) *(Infusion Therapy Standards of practice 2021).*

Source: Intravenous Therapy; Clinical Principles & Practice, J Terry 1995

The pH and TONICITY of INFUSATES IN RELATION TO BLOOD

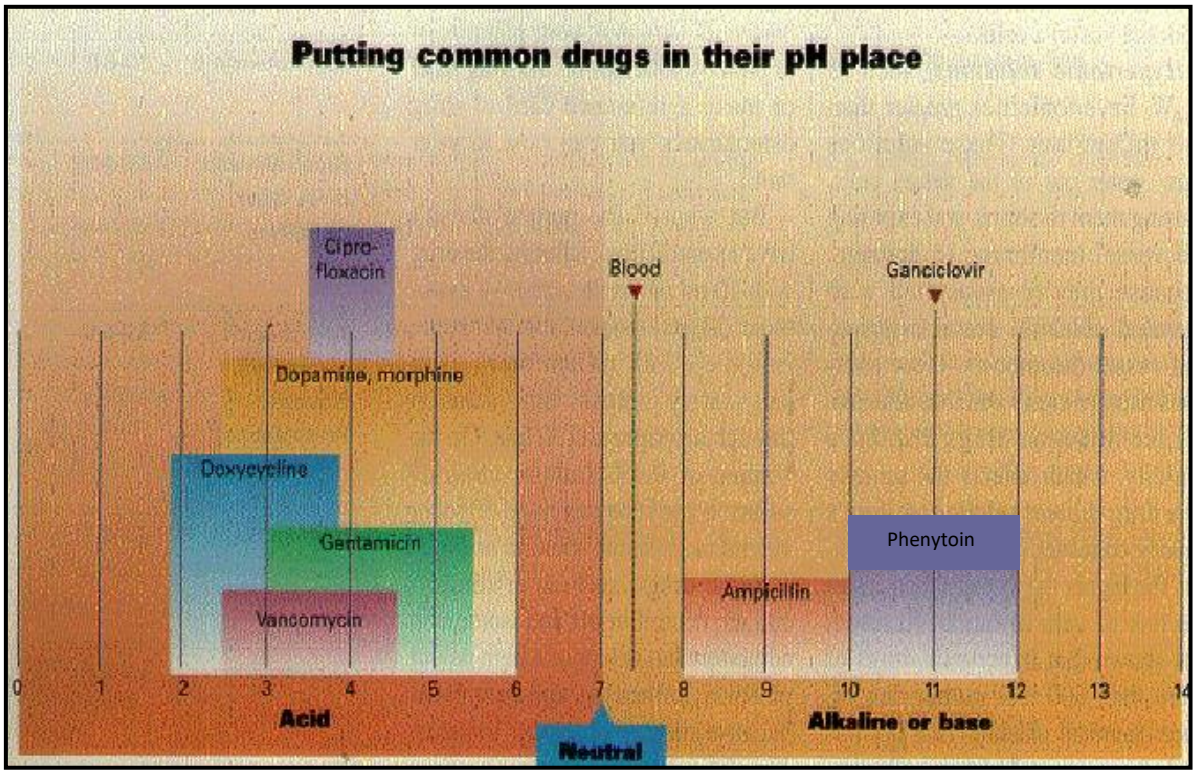


Fig.8: The pH of common drugs

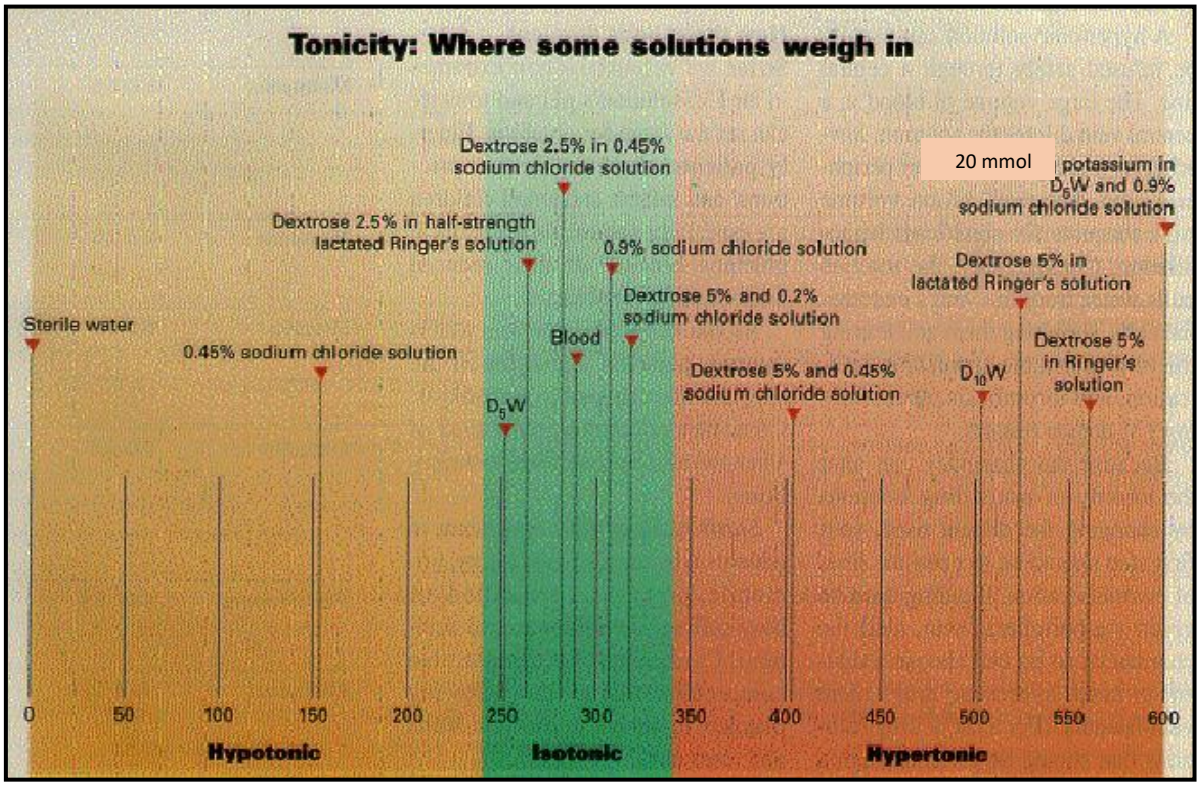


Fig.9: The tonicity of common drugs *Source: Intravenous Therapy; Clinical Principles & Practice, J Terry 1995*

BLOOD FLOW

Blood flow is primarily affected by the following:

- Diameter and shape of the vessel. When the vessel doubles in diameter, the flow rate increases sixteen times and is known as 'Poisuille's Law' or 'Fourth Power Law' (refer to figure 10.)
- Blood viscosity. As blood viscosity increases, flow rates decrease due to resistance.
- Flow rates. Described as either laminar or turbulent.

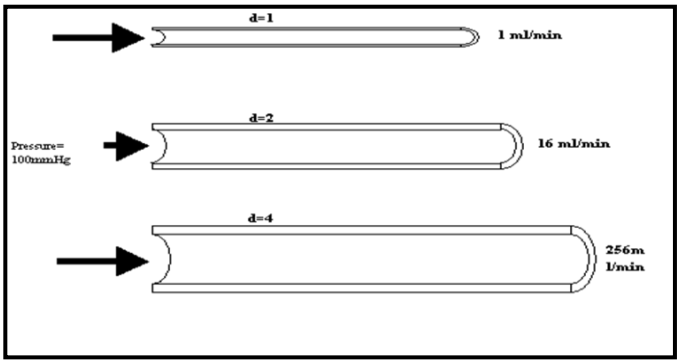


Fig.10: Poisuille's Law Source: Johnson & Johnson Medical

Laminar Flow

This is described as the normal movement of blood through a cylindrical vessel while taking account of the resistance exerted by the walls. In simple terms the blood touching the vessel wall moves slightly slower because of friction from cells lining the vessel wall. Blood in the center of the vein moves the fastest and with least resistance for example the flow in small peripheral veins. This gives a theoretical surface tension that can be represented as a curve (refer to figure 11).

Turbulent Flow

This describes a flow pattern which is created in a variety of circumstances. For example, when the inner layer of the blood vessel is rough; an obstruction is present; when there is a sharp turn in a vessel or when the flow rate is greatly increased. Higher velocity of blood flow, larger diameter of the vessel and lower viscosity all increase the potential for turbulent flow for example the flow in the SVC (refer figure 11).

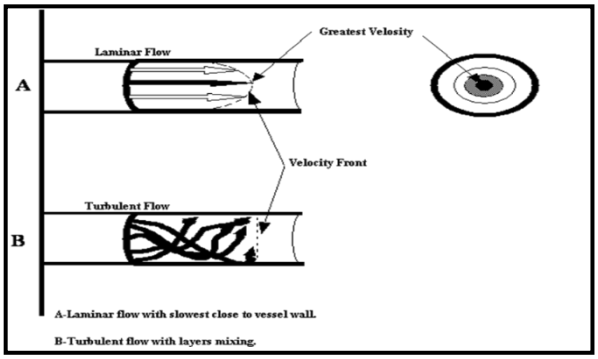


Fig.11: Laminar and turbulent flow Source: Johnson & Johnson

CVADs are used frequently in healthcare, but as they breach the body's skin defences they create a potential entry point for infection. Around 20% of healthcare associated blood stream infections(HABSI) are linked to the use of a CVAD (also referred to as catheter related blood stream infection (CR-BSI). CR-BSI occur when bacteria enter an intravenous catheter and spread to the patient's bloodstream. The microorganisms that colonise catheter hubs, access devices and the skin adjacent to the insertion site are the source of most BSI along with the colonised hands of healthcare professionals (refer to figure 12). Catheter hubs are a high source for infection (CDC Guidelines 2011). Where the catheter integrity has been breached e.g. the hub been left uncapped and left exposed for any length of time or the catheter has incurred physical damage, the catheter should be removed due to a high risk for infection. These infections exacerbate the patient's underlying health problem, prolong hospitalisation and increase the cost of care.

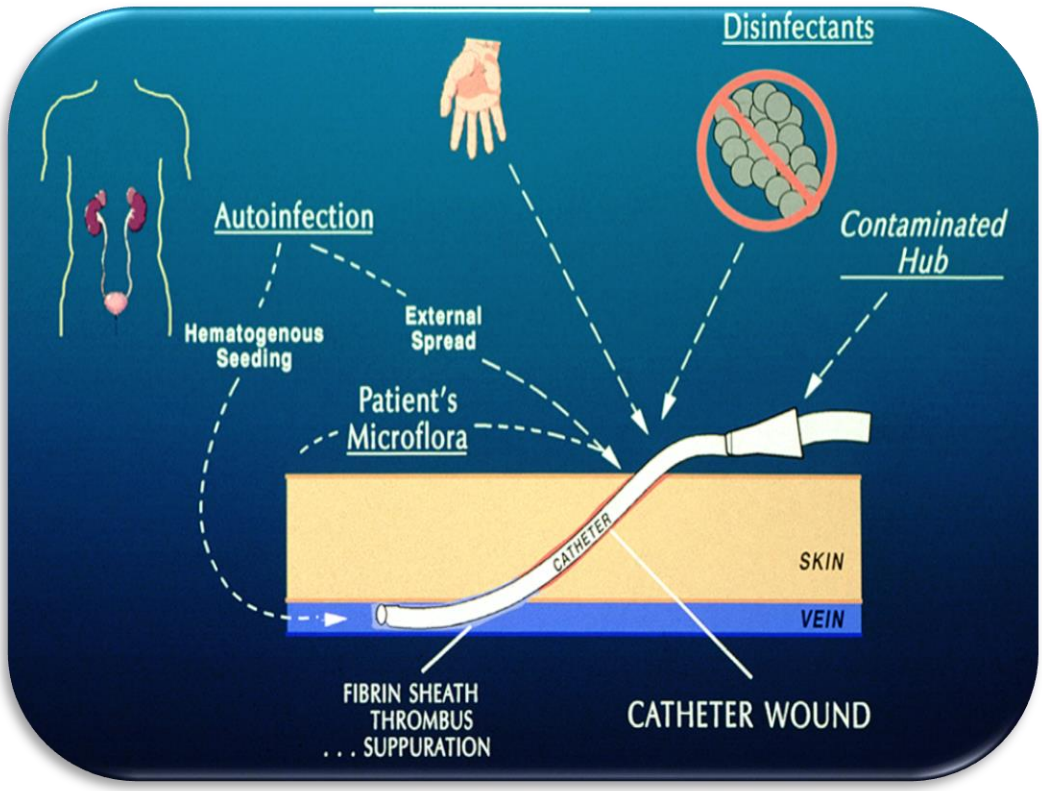


Fig 12: Sources of infection Source: Unknown

An evidence-based approach underlies the strategies for the prevention of CR-BSI. Interventions are based on the concept of 'bundles' of care components which incorporate individual practices that together result in greater improvements than when used individually.

The use of 'Bundles' hold people to process.

There are two care bundles of components aimed at the prevention of CR-BSI (Institute for Healthcare Improvement, 2008,CDC 2011).

CVAD insertion bundle

- Hand hygiene
- Maximal sterile barrier precautions
- Chlorhexidine 2% with 70% alcohol skin antisepsis
- Optimal catheter site selection

Fig.13 Source: Johnson & Johnson Medical

Table 3: CVAD insertion principles

Central Line Management	
Follow these important principles when inserting any central venous vascular access device:	
S	**crupulous HAND HYGIENE** Before and after contact with vascular access device and prior to insertion.
A	**SEPTIC TECHNIQUE** During catheter insertion. Wear a surgical mask and hat Wear a sterile gown and gloves. Use a large sterile drape.
V	**IGOROUS disinfecting** of insertion site with Chlorhexidine 2% with 70% alcohol.
E	**NSURE line** is removed when no longer necessary.
Your shortcuts can result in infections, loss of the "line", the patients quality of life and possibly their life!	

Source: Institute of Healthcare Improvement 2008

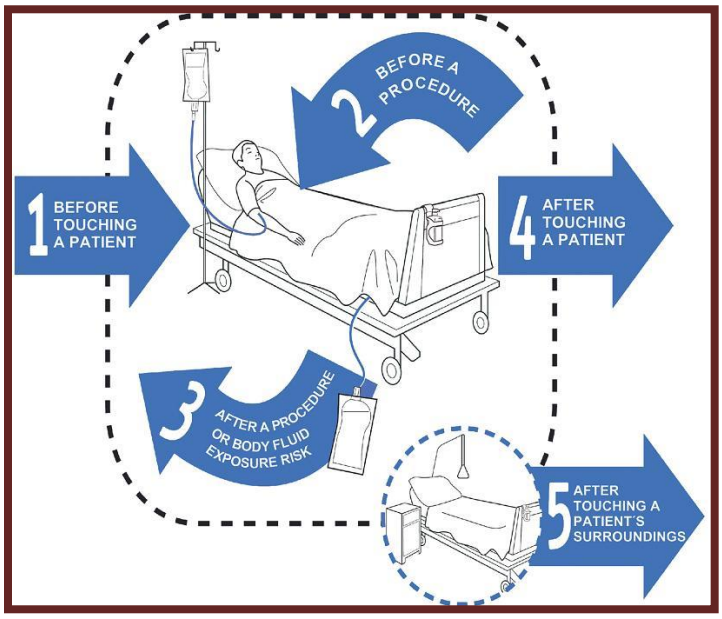
CVAD maintenance bundle

- Daily review and documentation of the CVAD necessity with prompt removal if not required
- Dedicated lumen for Parenteral Nutrition (PN) is the WHITE lumen of a multiple lumen catheter
- Access the CVAD lumens aseptically using chlorhexidine 2% and alcohol 70% wipes using vigorous friction prior to access, then **allow to air dry for 15-30 seconds (to ensure bacterial kill)**
- Review each shift and document the entry site of (CVC/PICC), exit site of tunneled catheters (Hickman/CICC/ TPICC / TFIC) including the surrounding area for inflammation

Other CVAD infection prevention principles include:

- Hand hygiene before and after manipulation of CVADs and administration set using the 5 Moments approach (refer to table 4)
- Aseptic and non-touch technique(ANTT) for all CVAD access and medication preparation
- The use of personal protective equipment

Table 4: Five CVAD moments for hand hygiene



Moment 1: Before Touching a Patient

- *Touching a patient in any way or any invasive medical device connected to the patient (e.g. IV pump)*

Moment 2: Before a Procedure / Aseptic technique

- *Insertion of a needle into an invasive medical device e.g. port access, IV flush*
- *Preparation and administration of any medications given via an invasive medical device, or preparation of a sterile field*
- *Insertion of, or disruption to, the circuit of an invasive medical device*

Moment 3: After a Procedure or Body Fluid Exposure Risk

- *After accessing a CVAD or undertaking the dressing*

Moment 4: After Touching a Patient

Moment 5: After Touching a Patient's Surroundings

Keep nails clean and nail length short.

1. Do not wear artificial fingernails or extenders; artificial or false nails have been associated with higher levels of infectious agents, especially Gram-negative bacilli and yeasts, than natural nails.

2. Avoid wearing nail polish; if organizational policy permits, nail polish should not be chipped as chipped nail polish may support the growth of microorganisms.1,3-6 (IV WHO. Guidelines 2009 CDC Guidelines 2020, ACSQ Guidelines 2019)

ASEPTIC NON- TOUCH TECHNIQUE (ANTT)

Aseptic Non Touch Technique (ANTT) is a technique that maintains asepsis and is non-touch in nature and performed in a logical order.

- **A**lways clean hands effectively (alcohol hand rub or hand washing)
- **N**ever contaminate key parts
- **T**ouch non key parts with confidence
- **T**ake appropriate infection prevention precautions

Non-sterile gloves are usually the logical choice however *if it is necessary to touch key parts of equipment or a key site directly then use sterile gloves. (Rowley v2)*

ANTT is used when:

- Drawing up from plastic poly amps
- Transferring diluents into drug bottles
- Drawing up from drug bottles and transferring drugs to IV bags
- Administering medication via the access device on a CVAD
- Flushing a CVAD
- Blood sampling from a CVAD
- Cleaning all access ports with friction using chlorhexidine 2% and alcohol 70%
- Allow to air dry for 15-30 seconds to ensure bacterial kill on equipment surfaces

ACTION: Identify key parts of the equipment you are using and do not contaminate (Rowley, 2001; INS, 2021). The circles in figures 14a, 14b, 15 and 16 below indicate key parts of equipment

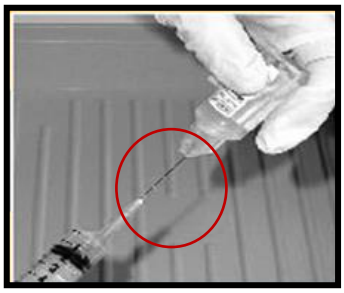


Fig.14 a Source: BD Medical

Fig.15 Source: Original Photo

Fig 14b Source: Original Photo

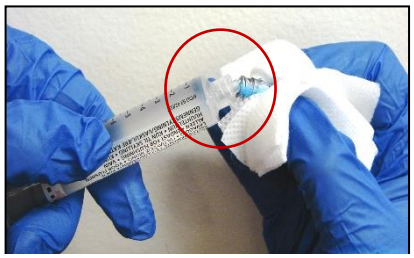


Fig. 16 Source: Original Photo

Shortcuts can result in infections, loss of the 'line', the 'patient' quality of life and possibly their life!

PRINCIPLES OF MAINTENANCE AND CARE

Management of Central Venous Access Devices requires us to maintain the patency of the catheter and vein (Hadaway, 2005).Knowledge and good assessment skills are essential when caring for a CVAD.

NB. For the management and care of Implanted Ports refer to the 'Catheter Specific' section on Implanted Ports


Formal written consent by the patient must be obtained prior to the insertion of a CVAD
The consent process for Child Health is completed by the Paediatric team with the parent/guardian. This should include the risks, benefits and alternative treatment options.

PRE-INSERTION

Education:

Patient education is essential to achieve best patient outcomes

- Ensure the patient and family / whanau understand why a CVAD is required, what is involved in the process and what to expect during and following insertion
- For children, this will include an-age appropriate explanation and involvement with the hospital play specialist
- Use a catheter diagram to explain what the catheter looks like, where it will be inserted and where the tip will reside (this can be sourced from this book and Patient Information sheet)
- Explain how the catheter will be cared for i.e. flushing, dressing and securement
- Encourage the patient to report any thing that doesn't 'feel right' or concerns them
- Ensure the patient is given the appropriate CVAD patient information sheet
- Instruct the patient and family/ whanau to always wash their hands or use alcohol hand sanitizers prior to touching the catheter
- Provide patient/caregiver with the appropriate Patient Information sheet such as the (PICC/Hickman/CICC/Port)

Hydration:

- Encourage oral fluids at least 1-2 litres or maintain prescribed IV fluids
- This helps dilate the veins and reduce insertion trauma to the vein
- Dehydration increases venous problems and viscosity which may make cannulation of the vein difficult

Warmth:

- Ensure the patient is kept warm. Use a warm blanket for this purpose
- This helps to dilate the veins by increasing blood flow and venous return to larger veins

POST INSERTION

Check catheter insertion site for:

- Bleeding / bruising
- Swelling
- Pain or discomfort
- Dressing and securement integrity
  Ensure Positive displacement devices (PDD) are securely attached to the catheter lumen/s, but do not overtighten. Flush all catheter lumens with sodium chloride 0.9%% to ensure patency is established before using catheter.
- Document any variances on the 'CVAD Management Form' and review catheter insertion details in patient's CORTEX records

Special Note:

- Surgical adhesive is applied to insertion site for haemostasis post insertion for all TPICCs, PICCs CICCs, FTCC's
- Adult PICCs secured with SecurAcath® subcutaneous securement device
- CICCs (tunneled cuffed catheters) stabilized with a WingGuard® until the internal cuff has engrafted
- Hickman® catheters with a suture (removed at 3 weeks) and a tube holder for external lumens
- Children's PICC are stabilized with a WingGuard® skin surface securement device

If the exit site bleeds the dressing must be replaced immediately. A wet surface provides a pathway for bacteria to travel to the wound along with catheter movement.

ONGOING ASSESSMENT OF THE CVAD

The CVAD must be assessed at least once eight hourly and:

- Pre and post administration of medications and fluids
- During continuous infusions
- During the administration of vesicant drugs
- During blood sampling
- During dressing changes
- During access device changes

The appropriate way to assess the insertion site for infection is to visually inspect it and palpate it through the dressing (category IB, CDC Guidelines 2011)

Assess the insertion site and surrounding area for signs of:

- infection, redness, leaking, swelling, induration
- swelling, pain, swelling (thrombosis) at neck, shoulder and extremity on the side where the catheter is inserted
- PICCs: all the above plus the mid upper arm, axillary area and hand, for swelling or phlebitis. Check the external catheter length 8 hourly and document findings in the *'CVAD Management Form.' Compare with insertion details in Cortex found under 'Insertion of CVAD' for the external length of PICC.*
- Ports: the portal pocket
- Document any variances in the '*CVAD Management Form' and in the patients CORTEX notes*

Protect the catheter during showering

- Avoid the catheter and dressing becoming wet. Don't submerge the catheter in water. Teach the patient how to protect the external catheter by covering it with plastic wrap or a plastic sleeve (for PICCs) and avoiding direct water contact for other devices (category IB, Centre for Infectious Disease (CDC) Guidelines, 2016)

DRESSINGS

An aseptic non-touch technique (ANTT) is used when dressing the catheter. If a Biopatch® is used place it around the catheter at the insertion site foam side down and replace it at each routine dressing change every 7 days or whenever the dressing requires replacement.

*Biopatch® is **NOT** used*

- *Unless clinically indicated*
- *For children or routinely for ICU* patients
- *Where antimicrobial or antibiotic coated catheters are used.*
- *Where Surgical adhesive is used at insertion site*

CHANGE DRESSING WHEN:

- Loose, lifting or visibly soiled
- Excess oozing/bleeding at insertion site
- If a Biopatch® has been used and shows signs of fluid absorption (has increased in size) or has been incorrectly applied i.e. foam side is not placed next to skin
- Where skin reactions have occurred refer to the *'Skin Reaction Management Pathway' on page 28* as a guide.

CLEANING THE EXIT SITE, SURROUNDING SKIN and the CATHETER

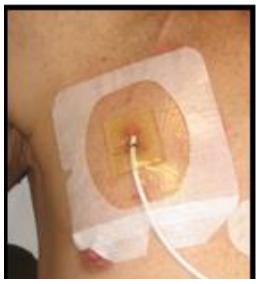
- Use 2% Chlorhexidine & 70% alcohol swab sticks
- Clean the skin using either circular or grid method is acceptable (INS.2021).
- Clean insertion site and along catheter portion that sits under dressing
- Allow to air dry for 15-30 seconds. Do not wipe the solution off (CDC Guidelines Recommendations)
- If blood is present at or around the insertion site, use STERILE WATER to clean and remove blood, then clean site with 2% Chlorhexidine (CHG) & 70% alcohol swabs.

Chlorhexidine 2% has demonstrated continued activity for up to six hours after application

- Cavilon® skin protectant is applied to the area, avoiding the insertion site and extending out beyond the dressing edges to help prevent the dressing edges lifting. Allow to dry.
- A sterile occlusive transparent semi-permeable dressing is applied over the catheter insertion site to protect the area and allow for visualization and early detection of complications.

ANTIMICROBIAL DRESSINGS: Use only when clinically indicated.

Biopatch® Chlorhexidine sponge dressing
Place around catheter at insertion site
Source: Original Photo



Tegaderm® CHG Dressing 2%.
Source: original photo

CATHETER SECUREMENT

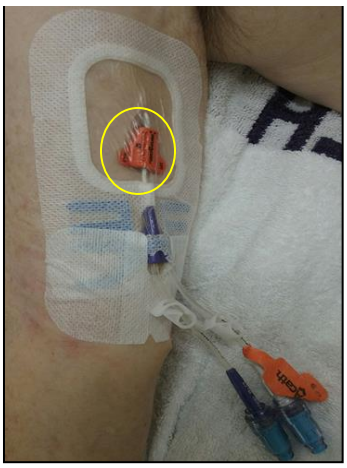
Catheter securement is a critical component of successful dressing management during all phases of catheter care, including dressing removal and site antisepsis. Catheter securement is a care issue that includes patient variables, practice variables, and product variables (Macklin, Blackburn 2015, Culverwell et.al 2020).

The dressing protects the insertion site, but the catheter securement system directly influences dressing management especially during dressing removal. Lack of movement of the catheter promotes healing at the insertion site allowing the new tissue to act as a barrier to surface bacteria. Three complications associated with inadequate securement are:

- Catheter migration
- Catheter related blood stream infection
- Thrombosis

PICC SECUREMENT METHODS

SecurAcath® –subcutaneous securement



Surgical Adhesive is placed at insertion site and for 2cms under the PICC

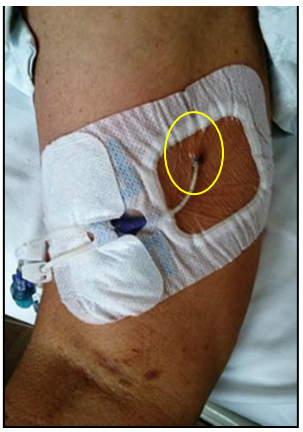


Fig 17: Source: original

PICC SECUREMENT SELECTION CRITERIA:

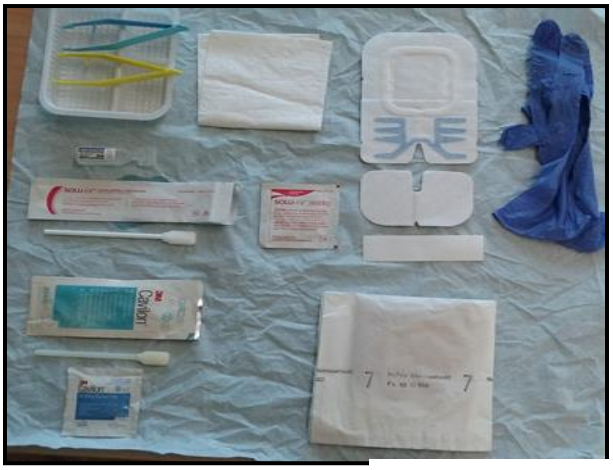
SecurAcath® fig 17. (Subcutaneous engineer securement device)-SESD is used to secure all Adult PICCs unless otherwise indicated. The SecurAcath measures 2cms in length.
For Video's on management: CLICK HERE, Removal: CLICK HERE , Information Poster: CLICK HERE

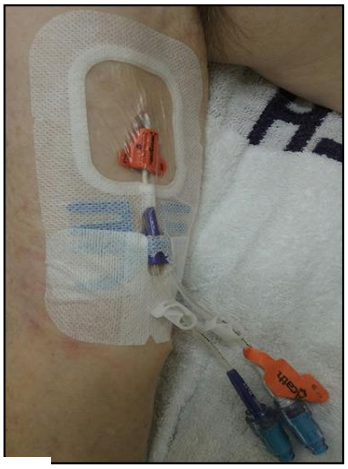
Surgical Adhesive may be used for:

- PICCs that are required for between 2 -3 weeks only. Ensure the PICC is positioned towards the outer side of the arm (see image above)

For information on management and care: CLICK HERE for Surgical Adhesive Information Poster

EQUIPMENT REQUIRED FOR DRESSING CVAD'S





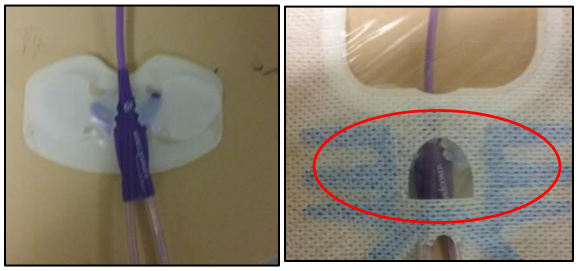
Images original with permission

PICC/CVC/CICC/TPICC/TFICC Dressing pack

Dressing Requirements
➢ Non-sterile gloves-to remove dressing
➢ Either sterile or non-sterile gloves for procedure, decision based on ANTT
➢ *CHG dressing (if clinically indicated) or Biopatch® if clinically indicated)*
➢ SorbaVeiw adhesive free zone dressing
➢ Solu IV® swab stick
➢ Tubing anchor for Hickman / Wing Guard CICC
➢ Cavilon® Skin protectant wand or wipe
➢ Sterile water (to remove any blood)
➢ Posiflush syringe
➢ Positive Displacement access device

Chest Tunneled CVC Securement Devices

Tubing Anchor® for DL & TL lumen Hickman®



Wing Guard securement for CICC

CLICK HERE to view CVAD dressing videos

CLICK HERE to review the CVAD Skin Reaction Management Pathway

POSITIVE DISPLACEMENT (PDD) ACCESS DEVICE CHANGES

All CVADs have positive displacement devices (PDD) attached to the catheter hub (exception Dialysis /Apheresis Catheters). PDDs are changed no more frequently than 72hrs or as required (CDC, 2011). It is important to establish regular change days. This ensures the catheter is not compromised and minimizes the potential for infection. Strict hand hygiene and the wearing of non-sterile gloves are required for this procedure.

Child Health please refer to the CVAD lock solution and volumes in 'Flushing Section'

SCRUB THE HUB

Organisms can be introduced via the catheter hub. It is essential to vigorously clean the hub and its luer lock threads with an antimicrobial wipe and allowing the solution to air dry before placing a new access device.

Catheter hubs carry the highest risk for infection and should be protected from contamination at all stages of the changing procedure (CDC Guidelines 2011).

WHEN TO CHANGE THE ACCESS DEVICE/s:

- Tuesday & Friday
- If the CVAD is accessed once weekly, change the access devices weekly
  EXCEPTION: Where the PDD has been compromised or if residual blood is evident and unable to be cleared with flushing, change PDD

REMEMBER: *If the PDD is not cleared of blood following flushing, the catheter lumen will not be clear of blood, resulting in catheter occlusion.*

Time weekly dressing change to coincide with PDD access device changes (Tuesday or Friday). This allows for catheter flushing, catheter assessment and patency flow checks.
An aseptic non-touch technique is used when changing PDD access devices. Ensure that all key parts of the equipment are protected and not contaminated during the procedure. (Refer to figure18)

Key parts of equipment are:

- Luer lock end of the syringe and IV administration set
- Catheter hubs
- Positive Displacement device luer lock area
- Positive Displacement device access port

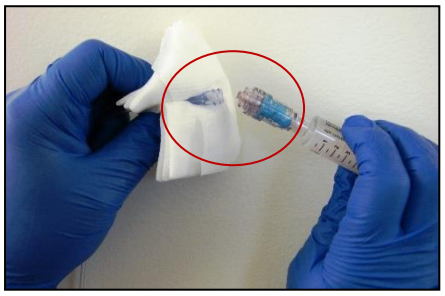


Fig.18: Key parts of equipment Source: Original Photo

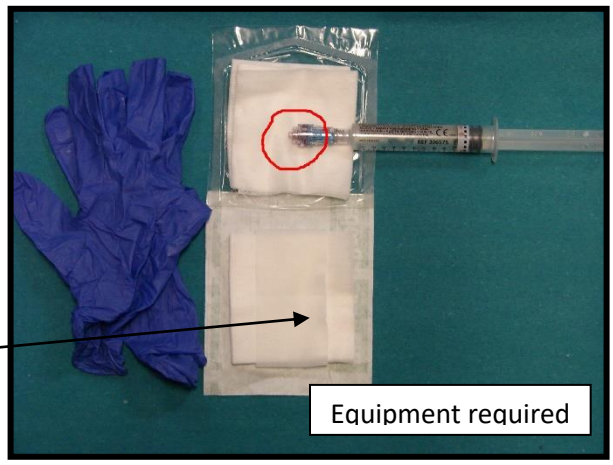
USE ANTT when CHANGING an ACCESS DEVICE and BEFORE administering a medication or flush

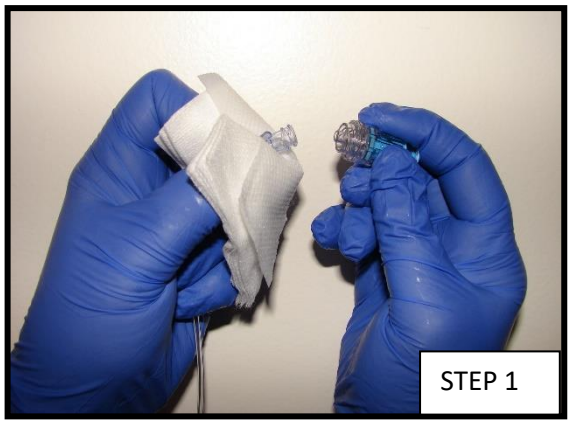
CLICK HERE to view the video

Source: Original Photos

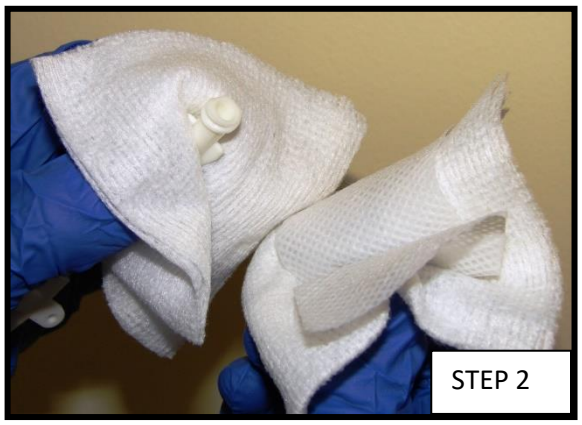
- Non-sterile gloves
- Sterile gauze
- Chlorhexidine 2% / 70% Alcohol wipes
- MaxPlus® (PDD)
- 1x 10 mL pre-filled sodium chloride 0.9% syringes

Antimicrobial wipe is placed onto the sterile gauze to hold the catheter hub

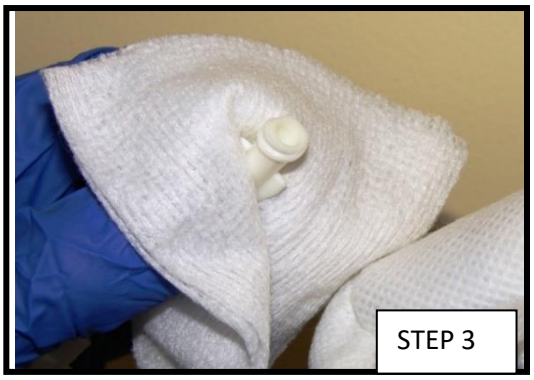




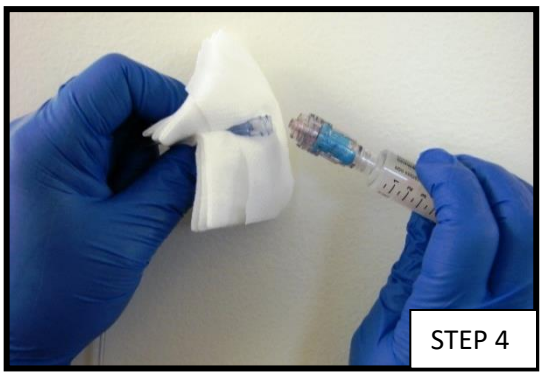
- Ensure catheter is clamped
- Hold catheter hub with gauze and antimicrobial wipe
- Remove PDD as demonstrated above



- Vigorously clean catheter hub & luer lock threads for 30 seconds



- Allow catheter hub to air dry for 15-30 seconds
- Protect the hub from contamination using the gauze and antimicrobial wipe

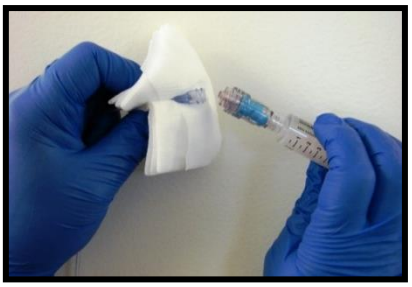


- Attach primed PDD without contaminating key parts of equipment
- Unclamp & flush catheter
- Disconnect syringe – count to 5 – now clamp catheter

FLUSHING THE CATHETER

Never forcefully flush a catheter as this can lead to catheter damage, mal-positioning and complications. 10 mL syringes are used to flush the catheter because they create less positive pressure within the catheter When administering medication by syringe method use 10 mL or larger

Flushing the CVAD involves significant manipulation of the access device site. Organisms can be introduced during this procedure therefore antisepsis is important to eliminate this potential. Infections are transmitted via bacteria found on the skin and hands. Non-sterile gloves are worn when accessing CVADs to administer flushes or medication and when changing PDD access devices. This protects the hands from blood contamination and descaling of bacteria from the skin of the healthcare worker onto key parts during the procedure (Rowley 2001, Rowley & Clare 2018)).
Always use sterile gauze with the antimicrobial wipe laid on top of the gauze when accessing the PPD or changing the PPD.



Factors that affect the flushing procedure:

- Understanding how positive displacement devices work
- Using the appropriate pulsatile flushing technique and the volume of flush solution
- Using correct catheter clamping sequence
- Correct use of the syringe – (standard versus pre-filled)

Points to consider when flushing catheters

- Catheter length adds resistance to fluid flow
- Never flush against resistance
- Flushing should be free flowing
- Resistance requires careful assessment to determine the cause
- The inner diameter of the catheter dictates the:
    - flow rate
    - amount of pressure the catheter can tolerate
    - priming volume for the lumen

MAINTAINING CATHETER PATENCY

Regular flush regimes along with the volume of flush solutions are important in maintaining catheter patency. The volume of flush solution should equal the internal volume of the CVAD and add-on devices plus 20%. Flushing should be carried out before and after the administration of fluids/medication; in-between each medications; blood product administration; PN; blood sampling. **NB.** *inpatient CVADs should be flushed at least once daily using 10 mL sodium chloride 0.9% to maintain patency.*

Child Health please refer to the CVAD 'Locking solution' chart page 31

USING A POSITIVE DISPLACEMENT DEVICE

A pulsating flush method using sodium chloride 0.9% is required to effectively clear the PDD and catheter lumen. Flushing small volumes continuously in a rapid *pulsating* flush is more effective in completely clearing the PDD access device than using a laminar flush (Manufacturer's recommendations). If the access device is not clear of blood the catheter lumen cannot be clear of blood and therefore the device must be replaced to avoid catheter occlusion (refer to figure 20)

Fig. 20 Blood in the PPD which must be cleared to avoid catheter occlusion PPD

ADULT CVAD LOCKING SOLUTIONS

- PICC /TPICC/TFICC – 10 mL sodium chloride 0.9%
- Hickman® /CICC– 10 mL sodium chloride 0.9%
- Groshong® - 10 mL sodium chloride 0.9%
- Non tunneled CVC – 10 mL sodium chloride 0.9%
- Ports- sodium chloride 0.9% 10 mL (for frequency refer Implanted Port section)
- * Dialysis and apheresis catheters (refer Catheter Specific Section)

CHILD HEALTH 0-15yrs CVAD LOCKING SOLUTIONS & VOLUMES

Catheter Type	Lock Solution	Age Group	Volume
PICC	0.9% sodium chloride	<1 year 5 mL minimum >1year 10 mL	Following intermittent infusions and weekly
Non Tunnelled CVC	0.9% sodium chloride	<1yr 0.5 mL minimum ≥ 1yr 10 mL	Following intermittent infusions and weekly
Hickman	0.9% sodium chloride	< 1yr 5 mL minimum ≥ 1yr 10 mL	Following intermittent infusions and weekly
Implanted Port	0.9% sodium chloride	<1 yr. 5 mL minimum >1year 10 mL	Following intermittent infusions When access needle removed and at 1 monthly intervals

Checking for blood return before administering medications:

Flushing alone does not confirm catheter patency flow. CVADs are flushed and aspirated to check for blood return PRIOR to administering medications or infusions. This is a *catheter assessment function* to identify catheter flow problems and identify potential complications. The absence of free-flowing blood is an indication of catheter malfunction or malposition. (INS 2021)

The following flushing regime is referred to as the 'S.A.S.' method.

S.A.S METHOD

S. sodium chloride 0.9% 5-10 mL flush then aspirate until blood return is observed. Remove syringe and discard. Flush catheter with 10 mL 0.9% sodium chloride then -

A. administer medication / IV fluids

S. saline pulsatile post flush using 1x 10 mL sodium chloride 0.9%

Infusion Therapy Standards of practice 2021

Remember to always use Posiflush 2 x 10 mL flushes following:

- Blood products administration
- Blood sampling
- PN

(CH ref to flush volumes table p 31)

MINIMISING CATHETER OCCLUSION FOLLOWING FLUSHING

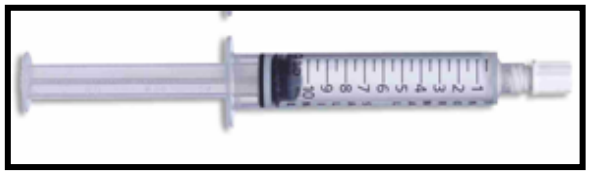
Several factors can cause unintentional reflux of blood back into the catheter lumen leading to partial or complete occlusion. These factors are:

1. Syringe design. Injecting all the fluid from a standard syringe into a catheter compresses the tip on the syringe barrel. When the pressure is released the plunger rod re-bounds drawing blood back into several centimeters of the catheter lumen. The narrower the catheter the longer the reflux distance. (Refer to figure 21)

a) *STANDARD SYRINGES*: When using the standard syringe to administer a saline flush NEVER FULLY EMPTY THE SYRINGE. Always leave at least 1-2mL mL in the syringe, then disconnect the syringe in the usual manner.

b) *PRE-FILLED SYRINGES*: These have ZERO reflux. This is due to the shape and design of the syringe. When flushing a catheter with a pre-filled saline syringe, the syringe can be fully emptied then disconnected in the usual manner.

Fig. 21: Standard Syringe = reflux



Pre-filled syringe = zero reflux Source: Original

2. Needleless connectors. A positive displacement device (PDD) is used on all CVADs unless otherwise indicated. The PPD withholds a small amount of fluid to overcome blood reflux. Disconnecting the syringe forces the reserve fluid into the catheter lumen.


REMEMBER to disconnect the syringe, count to 5 to allow for the fluid displacement to occur, and then clamp the catheter.

3. Aggressive Flushing

Aggressive flushing can shear off biofilm or thrombus and propel it into the blood stream. Aggressive flushing can be responsible for mal positioning the catheter (especially PICCs) resulting in incorrect tip position and 'whipping' of the catheter within the vein leading to perforation of the vessel

4. Changes in intra-thoracic pressure

Because there is no valve between the vena cava and the right atrium, some of the blood flows retrograde (backwards) with every heartbeat. Coughing, sneezing, vomiting, constipation, lifting heavy objects or heart failure can increase intrathoracic pressure, forcing blood into the catheter lumen. For example, if the patient coughs while the catheter isn't 'locked' blood moves into the lumen.

5. Muscle contraction

Muscles act as a venous pump that help the blood return to the heart. When a muscle contracts, proximal valves open while distal valves close. Pressure from the contracting muscle forces the 'locking fluid' out of the catheter lumen allowing blood to reflux when the muscle relaxes. Therefore, avoid strenuous activities that involve arm movement in patients with PICCs.

6. Changes in Infusion Pressure

Venous pressure in the hand is about 35 mmHg; at the upper arm it is about 8 mmHg; in the SVC it is 0 mmHg. Infusion pressure must be great enough to overcome venous pressure so that IV fluids can enter the systemic circulation. Fluid infusing by gravity from 120 cm above the patient exerts about 100 mmHg of pressure. When the infusion bag empties, the infusion pressure is 0 mmHg which allows blood to flow back into the catheter lumen. Most infusion pumps will maintain positive pressure and thus prevent blood reflux occurring.


Medications and IV fluids are administered via an infusion pump to prevent blood to reflux (flow back) into the CVAD lumen thus minimizing the potential for catheter occlusion

BLOOD SAMPLING

Blood sampling from CVADs is common practice. It is important to recognise that blood withdrawal can contribute to thrombotic catheter occlusion if the catheter is not adequately flushed. The INS '*Flush Protocols'* recommend at least 5-10 mL sodium chloride 0.9 %(catheter size dependent) following blood withdrawal from a CVAD. The most common method used to obtain blood is the discard method. The first aspirate of blood is discarded to reduce the risk of drug concentration or a diluted specimen (Boodhan, 2006). When a CVAD has more than one lumen, the largest lumen should be used for obtaining specimens.

Children: 1mL of blood aspirate is enough to confirm the catheter its free flowing. Use a 5mL sterile syringe to check blood flow where 3Fr PICCs are used.

The accuracy of samples can be altered when blood is drawn from silicone catheters. Some drugs leach into the silicone e.g. gentamicin and tobramycin (Boodhan, 2006*). **If drug levels for aminoglycoside or coagulation profiles are required from a single lumen CVAD flush the catheter / Port first with 20 mL sodium chloride 0.9% prior to blood sampling then aspirate 10mL blood discard before taking required blood tests (Boodhan, 2006).***

The syringe and/or vacutainer method is suitable for obtaining samples from all adult CVADs, the vacutainer method may not always be as reliable with PICCs that are 4Fr or smaller.

ACTION

1. Flush with 5-10 mL sodium chloride 0.9% using 10mL syringe. Aspirate 5mL discard blood to assess catheter flow. This provides a prompt as to which method is suitable for collecting blood samples – syringe or vacutainer
2. If blood does not flow into the blood tube or syringe have the patient cough, hold their breath, change position, or lift their arm
3. Replace blood tube with a new tube (the tube may have lost its vacuum)
4. Try using a smaller syringe e.g. 5mL (which has less negative pressure on aspiration)

Always ensure blood collection tubes are used in the correct order of draw to avoid cross contamination of additives and loss of integrity of the sample and results.

If blood cultures are required *do not flush the catheter first,* use the 'discard blood' for this purpose then take remaining blood samples in correct order of draw. *Click on hyperlink below for the CLAB Guidelines and a step by step guide to collecting blood cultures.* Click here

PARENTERAL NUTRITION: Always obtain blood samples at the completion of each PN cycle and prior to commencing a new infusion to provide a more accurate picture of the biochemistry profile or at the recommendation of the Dietitian. Do not interrupt the PN infusion to obtain blood samples. Always use the white lumen when administering PN. For further information refer to page 63-64

Clinical Haematology & Oncology follow in-house policy regarding PN.

SYRINGE METHOD

Click Here to view practice videos

*Please note the syringe method is **always** used for blood sampling in **Child health***

1. Check blood tests requested with patient's ID and select appropriate blood tubes
2. Hand hygiene and use non sterile gloves
3. Vigorously clean the access device with chlorhexidine 2% & alcohol 70%
4. Allow to air dry – 15-30 seconds (room temperature dependent)
5. Unclamp catheter
6. Flush catheter with 5-10mL sodium chloride 0.9% then aspirate for brisk blood return
7. Withdraw 5 mL of discard blood from Hickman®, CVC, CICC, Port and *2-3*mL from a PICC. Discard this blood and syringe before taking samples.
8. Clean access device then attach 10 mL syringe and withdraw blood sample/s. Disconnect syringe
9. Attach syringe to a blood transfer device **(PINK TIP)** and insert blood tubes in order of draw and allow tubes to fill. *The maximum fill is found on the tube.*
10. Gently mix blood tube/s
11. Vigorously clean the access device as above and allow to air dry
12. Pulsatile flush catheter with 2x 10 mL sodium chloride 0.9%
13. Disconnect syringe, count to 5 and allow displacement to occur
14. Clamp catheter
15. Label blood tubes with patient details and send to laboratory with blood request form

Practice Tip: consider using a 5mL syringe to obtain blood from the catheter if flow is not brisk.

Equipment used to perform blood sampling using syringe technique. (Refer to figure 22)

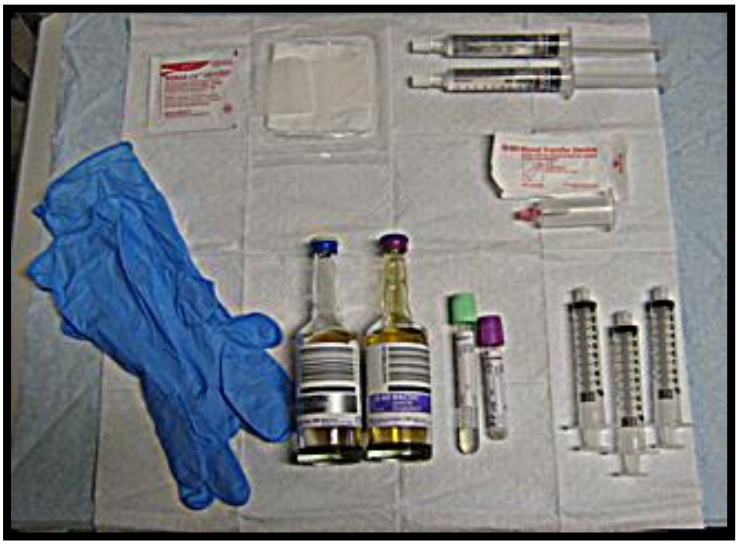


Fig.22: Blood sampling equipment Source: Original

- Non sterile gloves
- Chlorhexidine 2% & alcohol 70% wipe
- Sterile gauze
- 10 mL syringes as required
- **If flow is sluggish, try a** 5 mL syringe to withdraw blood from the catheter
- Blood transfer device (pink tip)
- 2x 10 mL sodium chloride 0.9% pre-filled syringes for flushes
- Blood tubes

VACUTAINER METHOD

Child Health: do not use the vacutainer method for blood sampling

ACTION The sterile vacutainer with a **BLUE 'MALE' LUER LOCK** is used for this procedure. If the blood collection is unsuccessful then the vacutainer must be discarded and replace with a new sterile vacutainer

1. Check blood tests requested with patient's ID and select appropriate blood tubes
2. Hand hygiene and use non sterile gloves
3. Vigorously clean the access device with chlorhexidine 2% & alcohol 70%
4. Allow to air dry – 15-30 seconds
5. Unclamp catheter
6. Flush catheter with 5-10mL sodium chloride 0.9% then aspirate for brisk blood return
7. Withdraw 5 mL of discard blood for Hickman®, CVC, CICC, Port and 2-3mL for a PICC
8. Remove syringe and discard blood sample
9. Clean access device allow to air dry, then attach a BLUE tip vacutainer to the access device and insert blood tubes in correct order of draw
10. Gently mix blood tubes
11. Remove vacutainer from access device
12. Vigorously clean PDD and allow to air dry
13. Flush with 2x 10 mL pre-filled sodium chloride 0.9% syringes
14. Disconnect syringe count to 5 and allow for displacement to occur
15. Clamp catheter
16. Label blood tubes with patient details and send to laboratory with blood request form

Equipment used to perform blood sampling using a vacutainer. (Refer to figure 23)

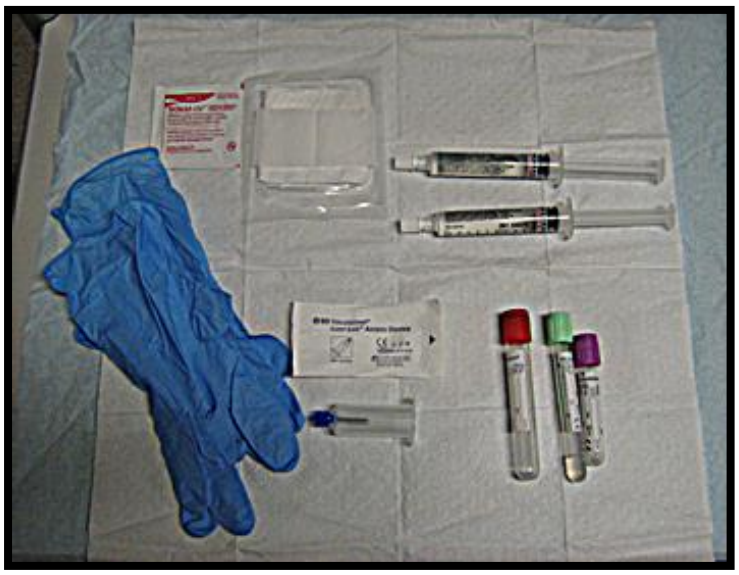


Fig.23: Vacutainer equipment Source: Original Photo

- Non sterile gloves
- Chlorhexidine 2% & alcohol 70% wipe
- Sterile gauze
- 10mL or 5mL syringe to take discard blood
- BLUE tip vacutainer holder
- 2x 10 mL sodium chloride 0.9% pre-filled syringes
- Blood tubes

COLLECTING BLOOD CULTURES from a CVAD

Blood cultures should be taken from a CVAD in combination with a separate peripheral IV sample when investigating potential catheter-related septicaemia. Samples should be taken from one lumen and clearly labelled as to which lumen the sample has been obtained from.

The peripheral vein sample is taken from the opposite side to where the CVAD is situated and should be collected first. Sets taken from either CVAD, peripheral or both sites should be obtained sequentially or within 12 hours of each other

ALERT: The access device must be removed, discarded and replaced with a new sterile device. Thoroughly clean access device and allow to air dry before attaching the syringe to collect the blood culture sample. This action prevents false positive results.
Refer to the CLAB Guidelines link below

The volumes of blood obtained from both sites must match to ensure accuracy e.g. if 10mL is obtained from the peripheral vein, obtain 10mL from the CVAD.

NOTE: Children do not routinely have a peripheral blood sample taken.

When taking blood from both the CVAD and from a peripheral vein, ensure that the site of each sample is clearly labelled on the culture bottles and the request form.

If additional blood tests are required these are taken after the blood culture samples

For a step by step guide on equipment required and how to carry out the procedure click on the

Procedure for taking blood cultures

CLAB Guidelines for blood cultures

Clinical Haemotology/Oncology refer to Local Policy Guidelines.

BLOOD CULTURE RECOMMENDED VOLUMES

Age Group	Total Volume	Aerobic Bottle	Anaerobic Bottle
Adult/Adolescent (peripheral)	20mL (recommended)	10mL	10mL
Adult/Adolescent (CVAD)	20mL (recommended)	10mL	10mL
CHOC	10mL (recommended)	5mL	5mL
Older children	5 mL maximum	5mL(optimal) paediatric pink bottle	
Infants	1-3mL maximum	3mL(optimal) paediatric pink bottle	
Neonates	1mL(min)-3mLaccording to weight	1mL(min)-3mL paediatric pink bottle	

Fig. 25: Blood volumes

It may not always be possible to obtain 20mL of blood from an adult. In that case divide the volume in half for each culture bottle. A minimum volume for adults is 5mL per bottle.

CATHETER REMOVAL

Reveiw CVAD daily and initiate prompt removal when it is no longer required.

- **Hickman catheter**: removed by Medical staff
- **Implanted ports**: removed by Vascular surgeon or IR consultant

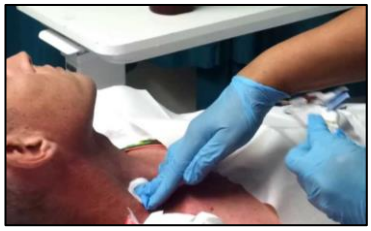


Fig.26: Removal of a CVAD

Registered Nurses and Midwives with CVAD endorsement and appropriate skills may remove:

- Non-tunneled Central Venous Catheters (CVC)
- CICCs
- PICCs, TPICCs,
- Femoral catheters /TFC

KEY POINTS FOR REMOVAL: (INS Standards 2021)

- Prevent air entering along the catheter tract when removing catheters.
- Position patient in a supine flat or Trendelenburg position (so that the insertion site is below the heart).
- Ask the patient to inhale and hold their breath during **removal** OR **remove** at the end of inspiration if mechanically ventilated.
- If patient is unable to lie flat, a low semi-fowler position may be used with head no greater than 30° head-up position during catheter removal.

PICC - position patient so that the exit site is at or below the level of the heart with arm out at a 90° angle from the side of the chest. Slowly withdraw catheter, then apply digital pressure slightly above insertion site until haemostasis is achieved.

TPICC-position patient with the arm out at a 90° angle from the side of chest. Slowly withdraw catheter applying direct pressure to axillary vein puncture site until haemostasis is achieved.

PICCs /TPICCs/TFICCs secured with a SecurAcath® always remove PICC first, then SecurAcath® ref healthLearn video

Femoral- place patient in supine position with the health professional positioned directly over the femoral site to ensure direct application of pressure at 90° is applied to the femoral vein puncture site until haemostasis is achieved.

Procedure using ANTT:

- Prepare equipment for removal
- Remove dressing and inspect site
- Position patient (as indicated in key points above)
- Clean site with chlorhexidine 2% and alcohol 70% wipe (if discharge is present take a swab for culture)
- Slowly withdraw catheter with dominant hand, applying digital pressure while holding sterile gauze at and just above exit site (refer figure 26) until haemostasis is achieve
- Apply an air occlusive sterile dressing with dressing pad for occluding the skin- to-vein tract and decrease the risk of retrograde air emboli. Leave dressing in place for at least 24 hours.
- Patient should remain in supine position for 30 minutes following procedure
- Inspect the catheter and measure to ensure all the catheter has been removed.

PICCs: if resistance is encountered it is likely due to a fibroblastic sleeve which has developed along a portion of the PICC. Research has found that it is a frequent but asymptomatic finding in oncology/ haematology patients. (Pittiruti et al 2019) Holding the PICC close to the insertion site, firmly pull PICC. This will usually free the catheter. If resistance persists, seek help

Documentation of procedure includes: catheter length, intact, exit site appearance, dressing applied patient's response.

CARDIO THORACIC PATIENTS: cover the site with a transparent dressing. The insertion site must be visible Leave for 24 hours unless contraindicated. **Directive - CARDIO THORACIC SURGEONS**

DOCUMENTATION

Nurses and Midwives are responsible for assessment of the patient; development of the nursing care plan to reach established goals and evaluate the effectiveness of the care given. The *CVAD Maintenance* form is used for this purpose.

Clinical effectiveness is about doing the right thing in the right way and at the right time for the patient
The importance of central line assessment and documentation of findings is often overlooked and can lead to complication which can be avoidable.
Effective documentation is an integral part of good patient care (INS, 2021).

Documentation provides a pathway to continuity of care. Each point of care reveals the patient's clinical picture therefore documentation on the '*CVAD Management Form'* C270118 /9 should accurately include the following:

- Patient assessment
- Catheter site and care assessment
- Catheter flow assessment
- External measurement of PICC /TPICC/TFIC
- Hickman® /CICC – check that **the cuff is not present** at the exit site which indicates migration
- Length and gauge size of non-coring needle used to access a Port
- Review of medications and infusates
- Any complications
- Interventions performed
- Evaluation of interventions including 'care bundles'
- Outcomes

  NB CVAD Insertion form is found on CORTEX under **Clinical Summaries** and CVAD removal form is found under **Procedures.** The CVAD Continuation Management form is in a paper version.

PATIENT EDUCATION

Based on a thorough assessment of the patient's needs, a plan is devised based on what needs to be taught; how the patient will be taught; overcoming barriers to effective teaching; and when and in what time frame the patient will be taught (INS, 2021). Use the appropriate catheter *'Patient Information booklet' for this purpose.*
Educational should be effective and family/whanau patient-centered and include the following objectives:

- Determine a clear understanding of what the patient needs to learn
- Determine barriers to learning and how the patient best learns
- Determine the goals for catheter maintenance
- Written information that will help the patient and family/whanau learn how to identify problems
- Deconstruct treatment information into understandable manageable units
- Promote self-care skills where appropriate

ACTION: Initiate the patient's education from the day of admission or as soon as possible.

COMPLICATIONS AND MANAGEMENT

The presence of a Central Venous Access Device (CVAD) places the patient at risk not only during the insertion procedure but for as long as the catheter remains within the vascular system. Key to identifying and managing post insertion complications is a comprehensive understanding and knowledge of signs and symptoms, related complications, preventive interventions and appropriate actions. Table 5 lists common complications associated with post insertion of CVADs.

Table 5: Common complications post CVAD insertion

- INFECTION
- OCCLUSION
  - Thrombotic
  - Non-thrombotic
  - Mechanical
- THROMBOSIS
- CATHETER MIGRATION
- MAL POSITION / VESSEL EROSION
- CARDIAC TAMPONADE
- LYMPH VESSEL DAMAGE
- PHLEBITIS (PICCs)

Although observing and evaluating the signs and symptoms of complications is important, prevention through good patient assessment and evaluation is the key to successful outcomes. These outcomes should be established on evidence based interventions which protect the patient from risks associated with infusion therapy.

It is important to document patient and catheter assessment and interventions that have been initiated along with the outcomes in the patients CORTEX care plan and Management form.

INFECTION

Infection interrupts the patient's prescribed therapy, impacts on the length of therapy the patient requires or receives and increases the length of hospital stay and cost.
Skin is a primary source of contamination along with catheter hubs. The source can either be from the patient's skin or hands of healthcare professional. Infection can be local or systemic. Risk factors for infection are institution related, patient related or a combination of both.

Institution Related Risk Factors

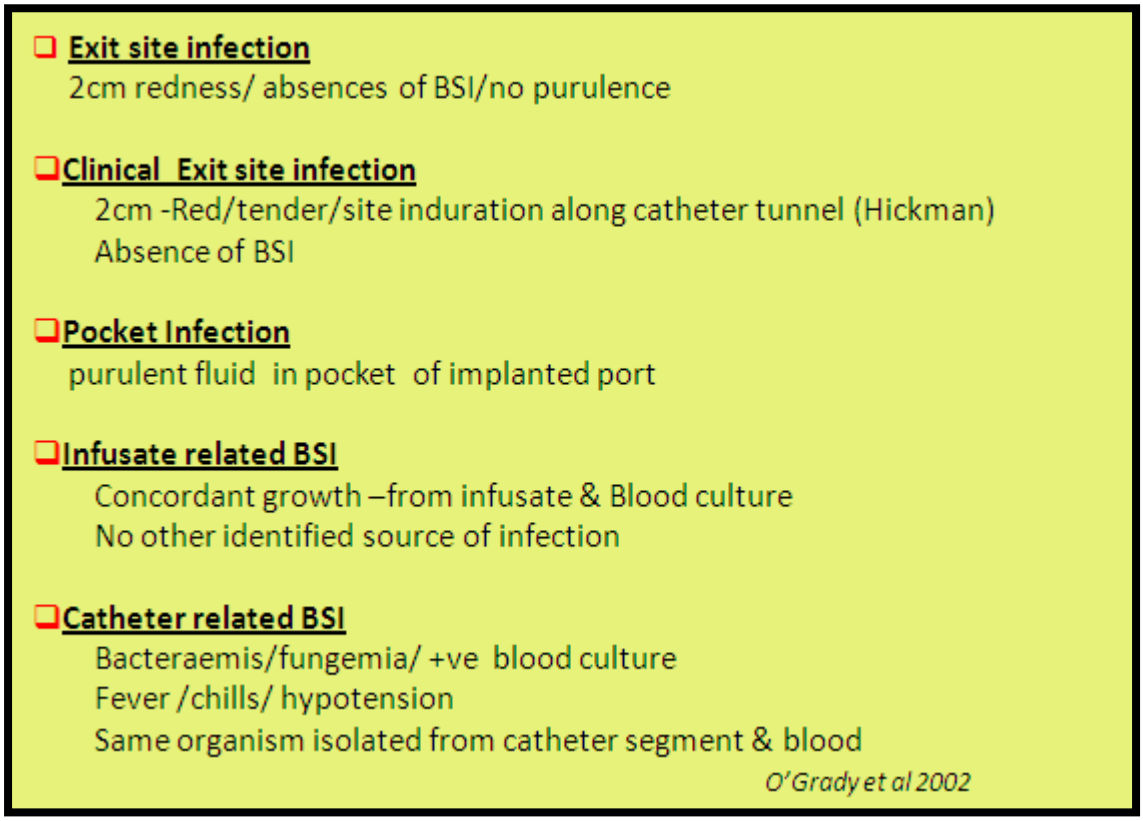
- Lack of understanding the principles of ANTT
    - Ineffective hand hygiene
    - Absence of effective asepsis
- Skill of inserter
- Non-adherence to maximal sterile barrier technique during insertion of the CVAD
- Substandard equipment
- Catheter material and number of lumens
- Maintenance and care
- Ineffectual catheter securement

Patient Related Risk Factors

- Immune suppressed
- Neutropenic
- Multiple blood product administration (Hanna & Raad, 2001)
- Poor nutrition
- Parenteral nutrition (Penel et al,2007)
- Renal failure (Hosoglu,2004)
- Chronic infection
- Diabetes
- Obesity
- Short bowel syndrome
- Oedema
- Vascular disease
- Self-care deficit – poor hygiene and ability to manage cares

The categories of infection have been described by O'Grady et al. (Refer to table 6).

Table 6: Categories of infection



BIOFILM

Biofilm is also a source of infection. There are two portals of entry for Micro-organisms:

- insertion site – external intraluminal pathway into blood stream
- catheter lumen

The micro-organisms attach to the fibrin, grow and develop a protective covering called biofilm

These grow into complex communities encased within a polysaccharide matrix.

Biofilm is responsible for promoting adherence of Staphylococci and Candida species which increase the risk of catheter related bacteraemia (CRB) (Shanks, 2006). This may account for acute febrile episodes experienced by the patient. Intra-luminal biofilm is responsible for rigors that occur when the catheter is flushed.

Heparin enhances Staphylococcus Aureus biofilm formation. In this setting, microbial metabolism is deranged and antibiotics are repelled (Shanks et al, 2006).

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DETECTING INFECTION

Daily assessment and monitoring of the following:

- The catheter exit site for redness and / or discharge
- Tunnel pathway of tunnelled catheters for swelling and induration.
- The portal pocket for swelling and redness
- Neck and upper arm for swelling, pain, redness

Monitoring for systemic changes:

- Fever
- Hypotension
- Tachycardia
- Chills/rigors
- Vomiting

MANAGEMENT OF INFECTION

If symptoms of a blood stream infection develop, blood cultures are taken Click here for procedure.
In addition, the following is also carried out:

- A swab is taken from the catheter insertion site if exudate is present
- A mid-stream urine specimen may be obtained and other tests may be ordered such as a chest x-ray
- Antibiotics will be prescribed and depending on the blood culture result the antibiotics may be reviewed and replaced with target antibiotics
- A clinical decision to remove the catheter may be

PREVENTION OF INFECTION

Knowledge of patients most likely at risk, good nursing assessment and infection prevention strategies are the key to preventing infection such as:

- Monitoring the patient for any changes in the vital signs and documenting outcomes
- Effective hand hygiene
- Aseptic non touch technique (ANTT)
- Vigorous cleaning of all catheter and infusion set access ports for at least 15 seconds, allowing time to dry before connection – 15-30 seconds. In a warm environment the dry time will be shorter, around 15 seconds
- Changing access devices on designated days or if the access device is unable to be cleared of blood or drugs during following flushing
- Effective catheter securement that prevents movement. Replacing dressing if it becomes compromised
- Infusion set changes every 72 hours. Exceptions, following blood products, PN, cyclosporine and some other drugs where the IV sets are changed at 24 hours or single use only
- Labeling IV administration sets to identify the infusion in progress e.g. *PN, cyclosporine, Maintenance fluids, heparin, insulin.* Maintaining a ‘closed system’ during Parenteral Nutrition (PN) administration. Where a double lumen catheter is used choose the white lumen.
- Good documentation of the patient and their vital signs, catheter site, catheter care and catheter function

PROPHYLATIC CATHETER LOCK SOLUTIONS

Prophylactic catheter lock solutions are referred to as *'locks.'* These are used to prevent catheter related infection (CRI) occurring in CVADs by reducing the bacterial biofilm that forms on catheter surfaces. They eradicate the microorganisms within the catheter lumen. The use of routine lock solutions is recommended for patients with a history of recurring CRI and who are at risk for serious consequences from these infections (Pittiruti et al 2016).

The following '*locks'* solutions are used in the CDHB.

ETHANOL 70%

Ethanol used either prophylactically to prevent catheter related infections (in particular the immune - compromised patient). (Chambers, Peddie & Pithie, 2006). (*Refer to table 6a for Guidelines)*. *Locks made up of ethanol 70% are instilled into each catheter lumen and left in the catheter lumens for 2 hrs. The locks are withdrawn or can be flushed through the catheter using 10 mL sodium chloride 0.9%*

Ethanol locks are made up in pharmacy.

ETHANOL SHOULD NEVER BE USED IN CATHETERS MADE OF POLYURETHANE

ANTIBIOTIC

Antibiotics are used to prevent infection in Dialysis catheters. This involves instilling highly concentrated antibiotics into the catheter lumens for up to 12 hours (Pliakos et al 2019)

DURALOCK-C trisodium citrate 46.7%

2.5mL (TSC) pre-loaded in 3mL syringes available from pharmacy. Used as a lock to treat catheter related infection and as an anticoagulant. *(Refer table 6a for Guidelines) Information for Administration see Appendix.* (Pliakos et al 2019)

Locks must be prescribed by a Medical Officer. When 'locks' are instilled into a catheter lumen, the RED medication label is used to identify the 'lock' solution. The label must also include the following wording "DO NOT USE (specify lock) LOCK IS PRESENT IN THIS CATHETER LUMEN". The labels are then attached to each catheter lumen.

ADULT CVAD LOCK SOLUTIONS - GUIDELINES FOR USE

PRODUCT	INDICATION	PREPARATION	ADMINISTRATION	REMOVAL
Ethanol 70% 1-2mL *Be aware that ethanol will soften catheter material* *Only use ethanol locks for CVADs made of silicone* **PRESCRIBED**: MedChart Protocols >search> CVAD > Locks **Route**: 'not applicable' **Dose**: 1-2mL **Qualifier**: Hickman catheter lock	• Prophylaxis • Catheter infection	Prepared in pharmacy Syringes will have a red seal over the luer lock cap on the end Store in refrigerator until required Check expiry date before use	Instil slowly into lumen/s Complete RED medication label with ethanol information and attach to external catheter lumen/s Leave for 2 hours unless specified	Remove ethanol from catheter lumen/s Flush catheter with 10mL sodium chloride 0.9% If unable to aspirate out ethanol flush through catheter then flush with 10mL sodium chloride 0.9% Remove RED drug labels from catheter lumens **Document** appropriately and follow the protocol
DuraLock-C™ (trisodium citrate) 46.7% in 2.5mL **PRESCRIBED**: MedChart Protocols>search>CVAD>Locks **Route**: 'not applicable' **Dose**: 1-2mL **Qualifier**: Polyurethane catheter lock	Alternative to heparin locks where there is indication of heparin sensitivity When ethanol is not an alternative (i.e. cannot be used in polyurethane catheters)	Pre-loaded 3mL sterile syringes Store at room temperature	Very slowly instil into each catheter lumen/s or implanted port over 8-10 seconds **IMPORTANT NOTE**: If unable to aspirate DuraLock-C™ from catheter use sodium chloride 0.9% 10mL syringe and **VERY SLOWLY** infuse over 10-20 seconds to minimise side effects as the solution enters the blood stream. **IMPORTANT NOTE**: Where a patient has been discharged to another health provider ensure the fill volume used for catheter lumen &/or portal body is documented on the Discharge form.	Remove DuraLock from catheter lumen/s prior to using the CVAD For Implanted ports may remain in for 1/12 when the port is not in use

Table 6a **(Refer to Guidelines for Administration in "Appendix" section)**

CATHETER OCCLUSION

Catheter occlusion is defined as a partial or complete obstruction of the catheter that limits or prevents the ability to withdraw blood, flush the catheter, and/or administer medications or solutions. It is a significant complication that may delay or interrupt therapy.
Catheter occlusions may be due to thrombotic, non-thrombotic or mechanical causes (INS, 2021)
It is imperative to recognise the TYPE of OCCLUSION and how it occurred so that it is managed appropriately. Clots that persist for more than seven days become resistant to thrombolytic treatment (Steiger, 2006), thrombotic partial or complete occlusions should be treated as soon as they are identified

Signs of Occlusion:

- Ability to flush but not aspirate blood is called a persistent withdrawal occlusion (PWO)
- Ability to aspirate but not flush is called a reverse ball occlusion(Ports)
- Resistance to flushing or sluggish infusion
- Inability to flush or infuse is called total occlusion
- Increasing alarm occlusion with electronic infusion devices

ACTION Do not leave partial occlusions untreated. Prompt action should be taken as soon as a partial occlusion is suspected to restore full patency and avoid a complete occlusion and possible catheter removal.

Education and knowledge is a key element to overcoming problems such as:

- Insufficient or incorrect flushing technique and clamping sequence to maintain catheter patency
- Unfamiliar with equipment and catheter add on devices
- Late recognition of problems / ignoring problems
- Inadequate assessment of occlusions
- Underestimating drug precipitate problems and lack of comfort with new drugs

Risk factors include:

- Coagulation abnormalities, blood viscosity, dehydration
- Chronic renal failure
- Haemoglobin < than 100
- Advanced age
- Hypotension
- Inflammatory process
- Device factors – multiple lumen
- Chemotherapeutic,nimodipine,vacomycin
- Blood products

Prevention of Occlusion:

- Use correct flushing technique and volume of flush solution
- Use pre-filled sodium chloride 0.9% syringes which have zero reflux
- Use a positive displacement device(PDD)
- Use the correct clamping sequence
- Treat partial thrombotic occlusions as they occur with alteplase (tissue plasminogen activator)

Type of Occlusion	Symptoms/Signs	Cause
Partial	Decreased ability to infuse or flush into the CVAD	Mechanical, Thrombotic or Chemical occlusion
Withdrawal	Inability to aspirate blood but able to flush without resistance Lack of free flowing blood return	Mechanical or Thrombotic Occlusion, fibrin tail
Complete	Inability to infuse or withdraw blood or fluid into the CVAD	Mechanical, Thrombotic or Chemical occlusion

Table 7: Types of occlusions

Four Categories of Thrombotic Occlusion

INTRA-LUMINAL

Occurs when back flow of blood into the catheter tip leads to the formation of an intra-luminal thrombus causing a partial blockage with decreased ability to flush and aspirate.

FIBROBLASTIC TAIL

This tail usually results in persistent withdrawal occlusion (PWO). Very slowly instilling alteplase into the catheter lumen/s using the *'over fill technique'* can address the problem. If this is not successful or and cannot not be removed under radiology guidance in Interventional Radiology, catheter removal is the only option.

FIBROBLASTIC SLEEVE

This is a sleeve of connective tissue can interfere with catheter function. Interventional Radiology may be able to remove the sleeve on larger catheters. If this fails, then catheter removal may be the only solution. *Click on link below*

MURAL THROMBUS

A mural thrombus occurs when the catheter irritates the vein wall and an accumulation of connective tissue / fibrin builds up in the catheter and may lead to a deep vein thrombosis. Catheter removal may be required.

MANAGEMENT OF OCCLUSIONS

Ensure the source of the occlusion is not mechanical or drug/lipid precipitate in nature. Refer to the:
ADULT Algorithm for Management of Partial, Persistent Withdrawal or Complete Occlusion
CLICK HERE

1. Deep breath –the catheter tip could be resting against vessel wall
2. Ask patient to lie down or sit up , move arm– it may be positional
3. Ask patient to cough -change intrathoracic pressure
4. Administer a brisk flush then check for blood return
5. Use a small 5mL syringe to aspirate blood if no blood return is obtained. This may result in more success.

CHILD HEALTH: Alteplase instillation for CVAD occlusions:

Type of CVAD	Max volume
Implanted Port	2mL
Tunnelled (Hickman®, CICC)	>1year=1mL and < 1year=0.5mL (each blocked lumen)
PICC	>1year =1mL < 1year = 0.5mL (each blocked lumen)

Alteplase is a recombinant form of the normal blood component tissue-type plasminogen activator (t-PA), which causes thrombolysis. It binds to and activates plasminogen, producing plasmin, dissolving fibrin, releasing fibrin degradation products and causing the clot to dissolve.

TECHNIQUES TO RESTORE CATHETER PATENCY

PRACTICE VIDEOS *for restoring catheter patency CLICK HERE*

The following methods have been described extensively in literature and provide reduced risk of catheter rupture or complications (Hadaway, 2012; Hamilton, 2006; INS 2021, INS An evidence-based Approach, 2010, CVAA 2019, Simcock, 2001). The direct instillation method is used when a catheter can still be flushed but flow is sluggish or aspiration of blood isn't possible due to intraluminal partial red cell occlusion or fibrin. Both the Negative aspirate, single syringe (refer figure 27) and three way tap methods for total occlusion use a negative pressure approach (refer to figure 28) to instill thrombotic and non-thrombotic catheter restoration agents.

DIRECT INSTALLATION METHOD (partial thrombotic or non-thrombotic occlusions)

1. Stop all infusions where possible when treating a suspected FIBRIN TAIL/SHEATH to ensure optimum thrombolysis during dwell time to facilitate maximum contact with fibrin.
2. Thoroughly disinfect the needleless connector with an antiseptic wipe using friction for at least 5 seconds and allow it to dry
3. Maintaining sterility of the syringe tip, attach the syringe containing alteplase to the needleless connector
4. Unclamp the catheter and slowly instill alteplase to ensure it comes in contact with the thrombus or clot burden and is 'soaked up' by the thrombus for maximum effect.
5. Remove and discard the syringe. Clamp the catheter. Place a red drug label on the catheter lumen which has written on it **"Declotting agent in place DO NOT USE"** and include the date, the time, and your initials (as shown)
6. Leave in the catheter for 60 -120 minutes then assess catheter patency. Thoroughly disinfect the needleless connector with an antiseptic wipe using friction for at least 5 seconds and allow it to dry.
7. Maintaining sterility of the syringe tip, attach an empty 10-mL syringe to the needleless connector, unclamp the device, and attempt to aspirate for blood return. Brisk blood return indicates patency
8. Sluggish or no blood return indicates that the occlusion is still present. A second dose of alteplase may be necessary.

NEGATIVE ASPIRATE METHOD (complete occlusion)

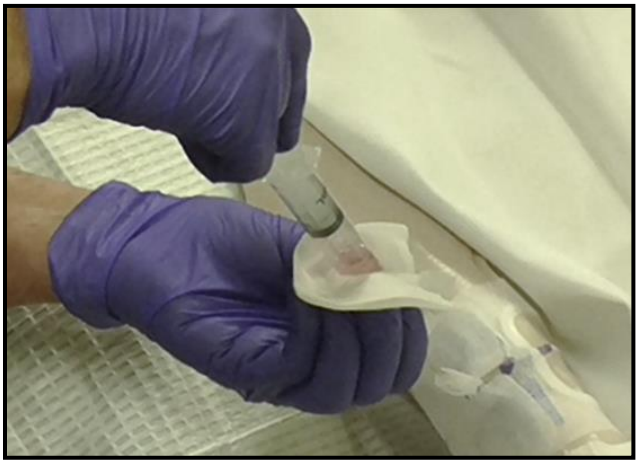
1. Use a 10mL standard sterile syringe containing 5mL 0.9% sodium chloride**.**
2. Thoroughly clean the needleless connector with an antimicrobial wipe for at least 5 seconds and allow to dry.
3. Attach to the syringe to the needleless connector and apply negative pressure by withdrawing the syringe plunger back 8-10mL repeat this process until blood is observed in the syringe
4. Once patency is re-established with brisk blood return then
5. Flush catheter lumen/s with 2 x 10 mL sodium chloride 0.9%. Consider following with alteplase

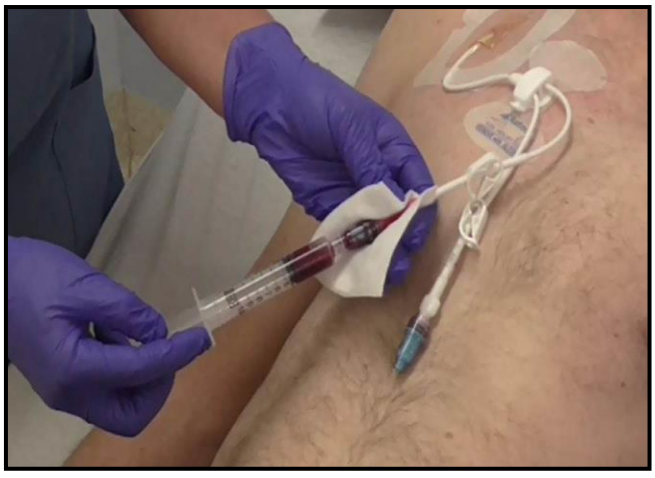
SINGLE SYRINGE METHOD (complete occlusion)

1. Thoroughly clean the needleless connector with an antimicrobial wipe for at least 5 seconds then allow to dry.
2. Attach a 10 mL syringe containing alteplase to the needleless connector of the obstructed lumen
3. Unclamp catheter
4. Hold the syringe vertically. Make sure the solution is in the end of syringe closest to the catheter
5. Draw syringe barrel back to 8mL mark
6. Keep syringe in vertical position and very slowly release the plunger to instil the alteplase into the occluded catheter lumen
7. Remove the syringe and clamp catheter
8. Place red drug label on catheter lumen which has written on **it 'Declotting agent in place DO NOT USE'**
9. Leave for 60-120 minutes then assess catheter patency. Thoroughly clean the needleless connector with an antimicrobial wipe for at least 5 seconds then allow to dry.
10. Unclamp the device, attach a 10mL sterile syringe and attempt to aspirate for blood return. Brisk blood return indicates that declotting was successful
11. Flush catheter lumen/s with 2 x 10 mL sodium chloride 0.9%.

Sluggish or no blood return indicates that the clot is still present. A second dose of alteplase may be necessary

Fig.27 a: Negative pressure syringe technique **27 b: aspirating blood return** Source: Original Photo





THE THREE-WAY TAP METHOD (complete occlusion)

STEP 1: CREATING A VACCUM IN THE CATHETER

- Thoroughly disinfect the junction of the central venous access device and the needleless connector with an antiseptic pad using friction for at least 5 seconds and allow it to dry.
- Clamp the catheter, remove the needleless connector, and then attach a sterile three way tap to the catheter hub. Turn the 3 way tap off to the patient and catheter hub.
- Maintaining sterility of the syringe tip, attach an empty 10-mL syringe to a 3 way tap port.
- Maintaining sterility of the syringe tip, attach the alteplase-filled syringe to the remaining port on the 3 way tap
- Open the 3 way tap to the port connected to the empty syringe.
- Unclamp the catheter while holding the syringe vertically, and then gently pull the plunger back to approximately the 8-10 mL mark and maintain negative pressure by holding the plunger position, close the 3 way tap to the negative aspirate syringe to maintain negative pressure within the catheter lumen.

STEP 2: INSTILLATION OF ALTEPLASE USING VACCUM IN CATHETER

- Turn 3-way tap ON to the 3 mL syringe containing alteplase.
- Allow the vacuum created within the catheter to draw the alteplase into the catheter lumen.
- The syringe barrel may need to be gently pushed at this stage to assist the uptake of the alteplase
- Once the alteplase is drawn into the catheter turn the 3-way tap to close the flow
- Clamp catheter

STEP 3: REMOVAL OF 3 WAY TAP AND LABEL CATHETER

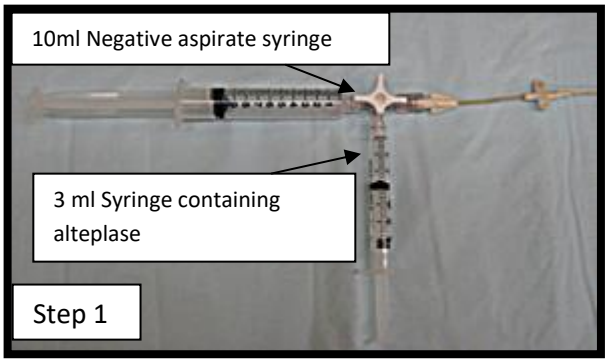
- Remove 3-way tap and syringes
- Thoroughly disinfect catheter hub allow to dry then attach a sterile combi loc to catheter hub
- Place RED medication label on catheter stating “Declotting agent in place DO NOT USE”
- Allow alteplase to dwell in the catheter for 60 -120 minutes before checking CVAD patency
- The longer the alteplase is left in catheter the more likely it will be successful in restoring flow. NB: alteplase may be left in the catheter overnight if required

STEP 4: EVALUATION CATHETER FLOW

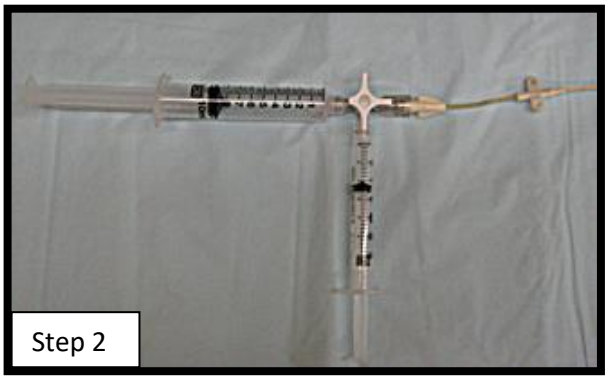
- Hand hygiene and put on non-sterile gloves
- Remove the combi loc thoroughly disinfect hub and attempt blood aspiration using a 10mL sterile syringe which has 5mL sodium chloride 0.9% in. If blood return is not immediate flush catheter using a quick ‘push’ then attempt aspiration.
- If successful then flush catheter with 1x 10 mL sodium chloride 0.9% pre-filled syringe
- Attached a newly primed PDD to catheter hub and flush with a second 10 mL sodium chloride 0.9% pre-filled syringe
- Document procedure and outcome in CVAD Management form

Source: INS. Infusion Nursing: An evidence –based approach 2010, INS Standards for Infusion Therapy 2021, CVAA 2019

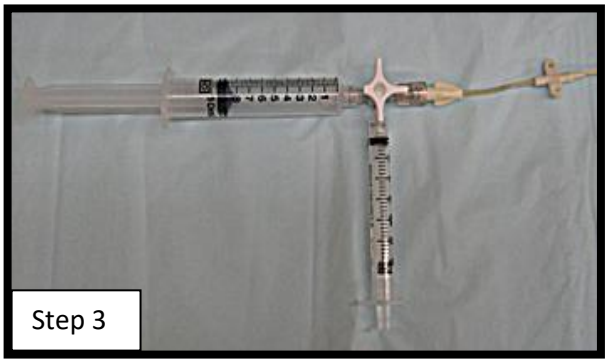
A STEP-BY-STEP GUIDE TO THE THREE WAY TAP TECHNIQUE



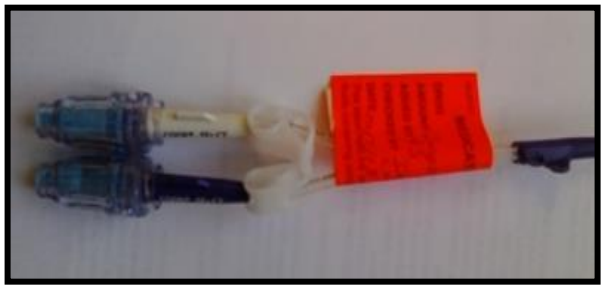
- Clamp catheter and remove PDD
- Attach a 3-way tap directly to the catheter hub
- Ensure 3-way tap is **OFF to catheter**
- Attach empty 10 mL syringe to the port on 3-way tap in line with the catheter
- Attach 3 mL syringe containing alteplase to the other port and ensure 3-way tap is now **OFF to the syringe containing alteplase**



- Unclamp catheter
- Ensure 3-way tap is **ON to catheter**
- Aspirate 10 mL syringe back to the 10 mL mark to create vacuum within catheter lumen
- Maintain negative pressure on syringe while turning 3 way tap **OFF** to negative aspirate and **ON** to syringe containing alteplase



- Vacuum will draw alteplase into catheter
- Once alteplase is in catheter turn 3-way tap to close flow
- Clamp catheter



- Remove 3-way tap and syringes
- Aseptically attach sterile combi loc to catheter hub
- Ensure catheter lumen/s have a medication label attached indicating *'declotting agent in place do not use'*
- *Leave alteplase in catheter for 60-120min*

Fig. 28. Source: Original Photo

NON-THROMBOTIC OCCLUSIONS

Non thrombotic occlusions include drug precipitates and lipid deposits. Drug precipitates may cause obstruction when incompatible medications or fluids are administered without flushing the catheter. One container of PN can cause a waxy buildup of lipids on the internal lumen of the catheter leading to occlusion.
For appropriate catheter restoration agents (refer to table 8).

Always confirm you have the correct product before instilling into the catheter

Table 8: AGENTS USED FOR NON-THROMBOTIC CATHETER CLEARANCE

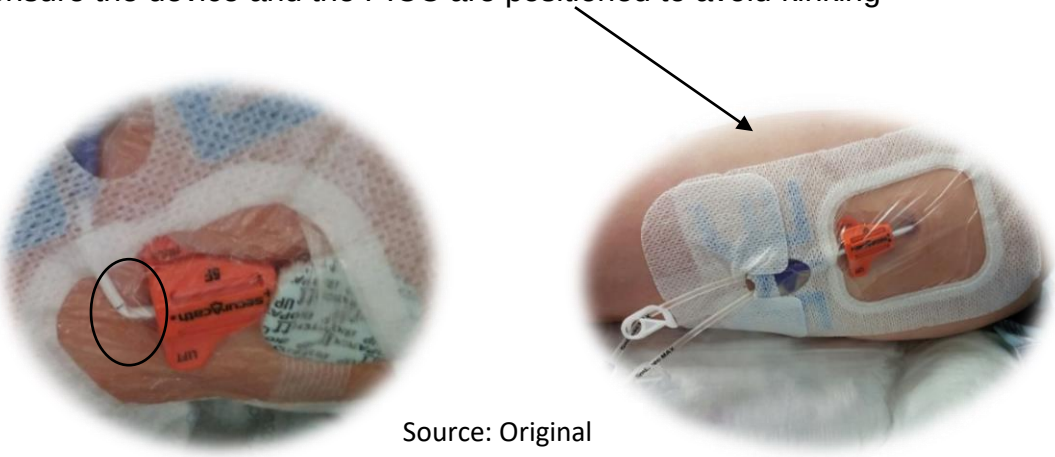
Precipitate/Occlusion	Clearing Agent	Dose	Fill Volume
High pH drugs(pH7-12)	sodium bicarbonate 8.4%	1 mmol/mL 60 minutes	Capacity of catheter
Fat /PN deposits	ethanol	70% 2 minutes	Capacity of catheter

Source: INS Infusion Nursing: an evidence - based approach 3 ed. 2010 – INS Infusion therapy Standards of Practice 2021, CVAA 2019

MECHANICAL OCCLUSION ASSOCIATED WITH THE SECURACATH® Key Points

(Culverwell et al 2020)

1. Always visually check the external portion of the PICC where it enters or exits the SecurAcath®.
2. Kinking of the PICC can occur due to the position of the dressing in relation to alignment with the catheter.
3. Polyurethane material has a memory and where kinking occurs it is difficult to remove the indentation.
4. Always ensure the device and the PICC are positioned to avoid kinking



Source: Original

PINCH OFF SYNDROME

'Pinch off syndrome' is a significant complication involving catheters and is often unrecognized. It occurs when a catheter is inserted away from the recommended subclavian vein site and is compressed by the clavicle and first rib. (Fig 30) The following catheters may be affected.

- Subclavian CVCs
- Implanted Ports

Catheter compression causes intermittent or permanent catheter obstruction and can result in catheter tearing, transection and catheter embolus most often to the right side of the heart or pulmonary artery (Masoorli, 2002; Mirza et al, 2004, INS 2021).

Signs and Symptoms:

- Intermittent and positional occlusion
- Difficulty with flushing, infusing, or aspirating
- Frequent occlusion alarm
- Occlusion relieved by specific postural changes such as rolling the shoulder back or raising the arm. This opens the angle of the costoclavicular space.
- Patient may experience chest pain, palpitations, swelling in the area of the CVAD
- Pain with flushing

Management:

- Supine chest x-rays at regular intervals is recommended for the first 6 months of placement to identify late occurrences.
- Interval between insertion and diagnosis can range from the day of insertion to 60 months with an average of 5 months.
- Catheter removal is recommended once diagnosed,
- Retrieval of embolised segment

Some patients have been reported as having no symptoms when the catheter partially or completely transects,

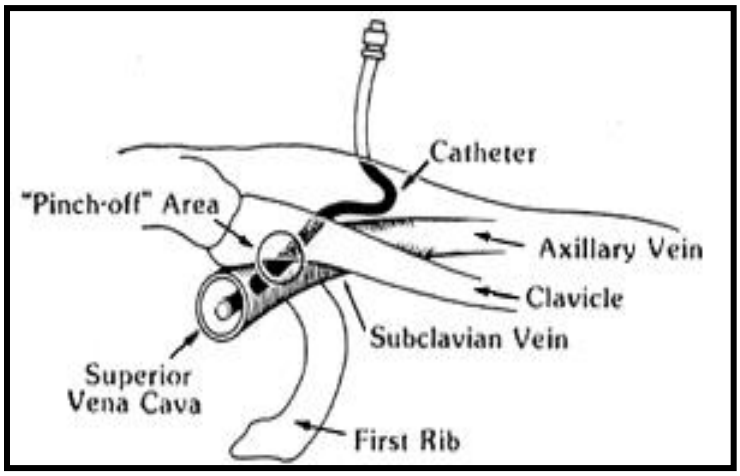


Fig.29: Catheter affected by 'Pinch off'

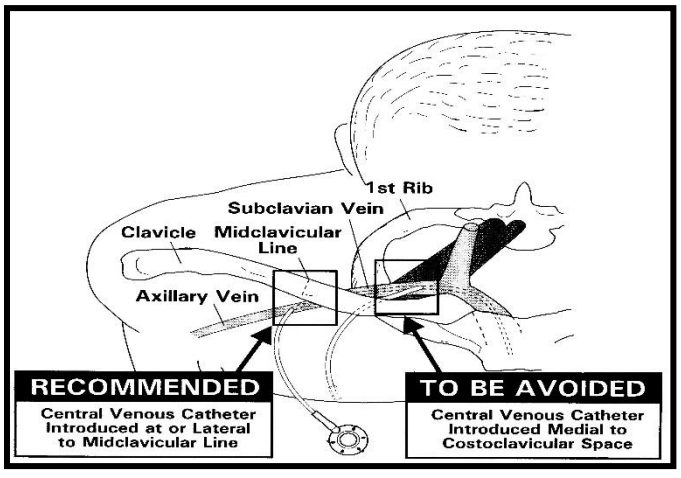


Fig 30: Recommended insertion area

Source: unknown

DEEP VEIN THROMBOSIS

The normal physiological response to a foreign body (such as a central venous catheter) in a vein is aggregation of platelets and the accumulation of fibrin. This process can take weeks or months to occur. As well as causing problems within the catheter, thrombosis of the central veins can occur. Thrombosis occurs when the blood has changed from a liquid state into a solid state producing a blood clot.

Three factors are implicated in the development of a deep vein thrombosis (DVT) referred to as Virchow's Triad:
1. Vessel wall damage or injury. Causes may be trauma; the presence of a CVAD; irritating solutions; if a PICC securement fails allowing the PICC to move
2. Alteration in the blood flow. Causes include CVAD too large for the vessel, venous stasis associated with immobility; obstruction of veins and heart failure
3. Hypercoagulability. Contributing factors such as decrease in coagulation inhibitors, pregnancy, malignancy and post-operative states.
4. COVID-19 related sepsis

Cancer patients: tumor biology activation may also be the source of thrombosis

Multiple lumens and left sided catheter placement is associated with DVT in tunnelled catheters. PICCs have a greater risk for DVT than catheters placed in the subclavian or jugular vein. Catheter tip position is a contributing factor if the tip is in the mid to upper SVC the risk of DVT is up to 48% greater than when the tip is at the cavoatrial junction (Infusion Therapy Standards of Practice 2021). (Chopra et al 2016).

Signs and Symptoms of thrombosis: (Kearon et al, 2008)

- Oedema of the arm, shoulder or neck on the side of the catheter placement
- Distended veins – the jugular vein may be quite visible
- Appearance of dilated collateral veins over the chest and upper arm
- Pain around the area and ear discomfort with a feeling of pressure
- Difficulty breathing (if the trachea is compressed)
- Darkening of the skin in the upper body
- Changes in colour of the hand on the effected side (plum colour)
- Leaking of fluid at the insertion site

Management of thrombosis: (ACCP Guidelines)

- Assessment and Ultrasound to identify vein thrombosis
- Catheter removal is not routinely required if it is functioning, necessary with no evidence of infection
- Systemic anticoagulants
- Consider antibiotics
- If the catheter is removed and replaced a further DVT can develop

CATHETER MIGRATION / MAL POSITION/VESSEL EROSION

Catheter migration occurs when the internal catheter tip changes position with or without the external length changing. Catheter migration causes the infusion to flow against the direction of blood flow. PICCs are more likely to migrate or become malpositioned due to length and small diameter compared to catheters with larger diameters such as the Hickman® or CVC.
For PICC tip safety Click here

Causes of catheter migration:

- Forceful flushing
- Changes in the intrathoracic pressure from:
  - vomiting
  - coughing
  - constipation
  - sneezing
  - heavy lifting
- Heart failure
- Presence of tumors in the chest
- Mechanical ventilation
- The cuff in tunnelled catheters dislodges or fails to adhere to the tissue after insertion

 PICCs can migrate into the following veins: internal jugular, azygos or contra lateral brachiocephalic. The tip impinges on the vein wall increasing the risk of vein thrombosis and vessel wall perforation *or* cardiac tamponade. In the elderly and / or obese the azygos vein opening is larger and may contribute to mal position into this vein.

Signs and Symptoms of catheter migration:

- Inability to flush, infuse, aspirate may be a sign the tip is no longer in the SVC
- Leaking of IV solutions or flushes at insertion site
- Loss of CVP trace or arrhythmia if catheter has migrated into the right atrium
- Changes in the external catheter length
- Gurgling in ear during flushing indicates the tip has migrated to the internal jugular
- Headache; pain; swelling; redness; shoulder, arm or neck discomfort
- Coldness felt in middle of back on flushing indicating tip migration into the azygos vein
- Tunnelled catheters – cuff visible at insertion site; coiling of catheter in tunnel, able to palpate coil in tunnel

Management of catheter migration:

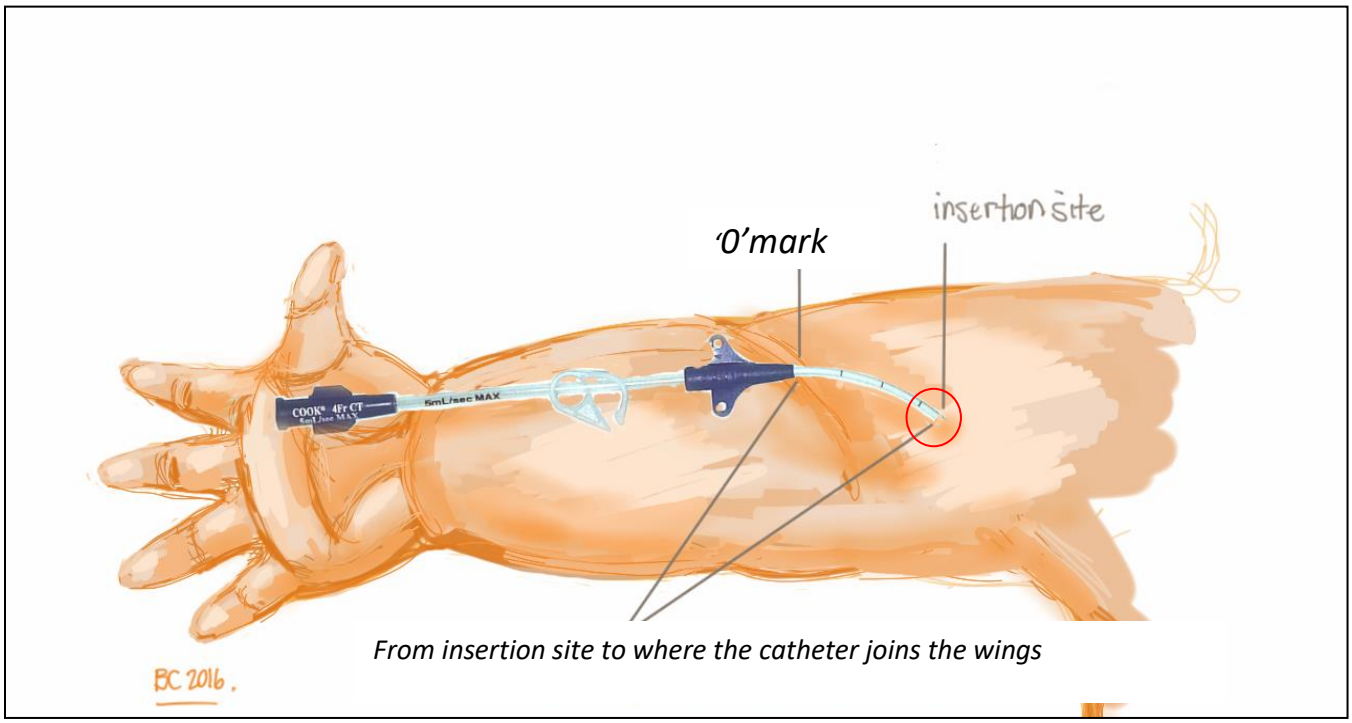
- Robust catheter assessment
- Avoid forceful flushing
- Effective catheter securement devices
- Palpate for correct cuff position with tunnelled catheters
- X-ray to verify tip location. Reposition under fluoroscopy if applicable
- Removal and replacement may be necessary

CHILD HEALTH PICC MIGRATION- IMPORTANT ACTION

Type of migration ***Action required***	**Children over 1 year**	**Infants under 1 year**
Migration IN	1-2 cm	0.5 cm or more
Re-position and re-check	Where a PICC has migrated **IN** from the original position follow the steps below: 1. Pull the PICC back to its original mark as documented in CORTEX on the IR CVAD Insertion form and document actions taken in the CVAD Management Form 2. Chest x-ray to confirm tip location 3. *Do not use the catheter until Radiology has reviewed the chest x-ray*	
Migration OUT	**Children over 1 year**	**Infants under 1 year**
Acceptable migration OUT	2 cm or less	1 cm or less
Continue to monitor	Where a PICC has migrated within these acceptable limits, it may be used, however it must continue to be monitored as usual.	
Unacceptable migration OUT	greater than 2 cm	greater than 1 cm
Determine position ***Remove PICC***	Any migration greater than these acceptable limits requires a chest x-ray to confirm PICC tip position before commencing any IV therapy. Document any variances or interventions on the CVAD Management Form **Where EXTERNAL migration is GREATER THAN 2cms** **The external catheter cannot be re-inserted because it is considered a source of infection.** **The catheter will need to be removed and replaced if still required.**	

Child Health:

Image showing PICC placement and correct external measurement



From insertion site to where the catheter joins the wings

With permission: **Source**: Becky Conway©

CARDIAC TAMPONADE

Cardiac tamponade, in relation to central venous access devices, is where the vein, right atrium or ventricle wall is perforated due to erosion by the CVAD tip. This perforation allows excess fluid to be present between the pericardium and the heart. The fluid causes abnormal pressure and prevents the heart from beating normally (Forauer, 2007).

Signs and Symptoms of cardiac tamponade:

- Unexplained hypotension
- Arrhythmia
- Chest tightness
- Shortness of breath up to one hour post catheter insertion and up to removal of the CVAD if it dislodges from its position

Always be extra vigilant if a patient has a PICC in place

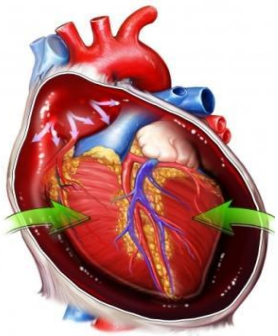
Management of cardiac tamponade:

- An emergency echocardiogram will be required to diagnose cardiac tamponade
- Signs and symptoms should prompt immediate treatment to relieve cardiac compression

Prevention of Cardiac tamponade requires that:

- Robust patient assessment and catheter assessment post insertion and for the expected dwell of the CVAD
- Accurate assessment of the patient post insertion is carried out to ensure appropriate action is taken if indicated
- Accurate documentation is undertaken especially the external length of a PICC
- The tip of the CVAD to be placed above the pericardium reflection to avoid cardiac perforation
- Heart monitoring be carried out which can give an accurate picture of the tip position. CVADs placed using electrocardiograph guidance reduces the need for routine chest radiography after central line placement (Davis, 2008).
- Catheters are made of less stiff material
- A flexible J-wire is used to aid in avoiding puncturing the heart or SVC wall during insertion

CARDIAC TAMPONADE IS A MEDICAL EMERGENCY



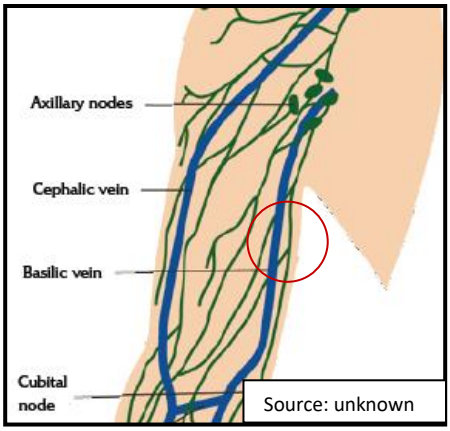
INSERTION TRAUMA TO LYMPH SYSTEM

The lymphatic system is an essential component of the immune system. A vast network of lymphatic vessels collects excess fluid from the cells and subcutaneous tissue in order to minimise fluid accumulation. Lymph is a watery fluid derived from plasma. It is transported in one direction towards the heart via the lymph system.

In the arm, the main lymph nodes are the superficial supratrochlear gland above the antecubital fossa and the deep glands of the axilla. Both are responsible for lymph drainage of the arms.

A network of lymph vessels is responsible for the transportation of lymph fluid between the glands**.**

The close proximity of lymph vessels to the veins used to place PICCs in the upper arm varies from one individual to another, so it is impossible to predict their location in relation to the vein.



<u>Cause of lymph fluid drainage from the insertion site</u>:

- A lymph structure is penetrated during placement. It may not necessarily be recognised immediately during PICC insertion because of the dominant return of blood through the small bore-needle used to access the vein.
- A lymph structure has been inadvertently punctured during insertion. This will lead to the formation of a channel between the lymph structure and the PICC exit site creating a passage for lymph fluid to drain from the vessel towards the exit site.

<u>Symptoms of a punctured lymph structure:</u>

- Serous fluid leaking from the insertion site of the PICC
- The fluid may be slightly blood- stained or straw coloured similar to plasma
- There are no signs of infection, redness, swelling or pain
- The exudate may be minimal if a smaller vessel has been punctured or more substantial if the supratrochlear gland is punctured

Management of a punctured lymph vessel:

- There are no clear guidelines available however management will be dependent of the amount of lymph drainage from the PICC insertion site.
- Excessive drainage may require PICC removal especially where there is a potential for PICC migration
- If the lymph drainage is not excessive then it is suggested a 'watch and wait' approach is an appropriate strategy with monitoring of the drainage
- If symptoms last beyond 2 weeks or there is an increase of drainage the PICC should be removed. (Hughes 2013)

ACTION POINT:

A consequence of excessive lymph drainage around the exit is erythaema, and excoriation of the skin due to the corrosive effects of the fluid pooling under the dressing.

Consider using Sorbaveiw 2000 dressing which wicks fluid away from the skin

Click here for CVAD skin reaction pathway

AIR EMBOLISM

Air embolism is caused by the entry of air into the vascular system creating an intracardiac air lock at the pulmonic valve which prevents the ejection of blood from the right side of the heart. (Lanfranco et.al 2017,Brobeck et al 2018,McCarthy et al 2016)

Causes of air embolism:

- Catheter fracture
- Disconnection of IV administration sets with catheter not clamped
- Unprimed lines
- Deep inspiration during catheter removal /access device change
- Presence of a persistent catheter tract following CVAD removal
- Contrast administration

Signs and Symptoms of air embolism:

- Hypoxia and gasp reflex
- Hypotension
- Pallor
- Palpitations and arrhythmias
- Chest and shoulder pain
- Loss of consciousness
- Distinctive 'mill wheel' murmur(churning sound) (Peter & Saxman,2003) is heard over the precordium caused by right atrial and right ventricular outflow obstruction

Management of air embolism:

- Position the patient in left lateral Trendelenburg
- Administer oxygen
- Call for assistance
- Hyperbaric treatment may be necessary

Prevention of air embolism:

- Position the patient in supine position or with head slightly tilted down position so that CVAD insertion site is at or below level of heart during CVAD removal
- Ask the patient to hold their breath during **removal** or **remove** at the end of inspiration if mechanically ventilated at the end of inspiration during catheter removal
- Slowly remove the catheter and place pressure over the exit site for a minimum of 5 minutes
- Maintain a supine position for 30 minutes following catheter removal
- Always use luer lock syringes and IV administration sets
- Always clamp the catheter during access device PDD changes and when the catheter is not in use

IMMEDIATE ACTION IS REQUIRED FOR THIS MEDICAL EMERGENCY

Fig.31: **Intracardiac air lock air** Source: unknown

PICC Related PHLEBITIS

Phlebitis is described as inflammation of one or all three layers of the vein wall. Phlebitis is associated with the physical mechanical properties of the catheter, its gauge, length, stiffness, and material composition—with traumatic movement of the catheter relative to the vessel wall and to the hydrodynamic effects of infused fluids. This initiates the inflammatory response. The presence of a catheter can result in an enlargement of the puncture site which provides the perfect environment for bacterial migration down the extra luminal pathway (MacMillan et al 2018, Pittiruti et al 2019).

Causes of phlebitis:

- 'Catheter to Vein' to ratio is not appropriate for the vein diameter
- Difficult insertion causing trauma to the vein wall
- PICC movement resulting in irritation to the vein wall
- Bacteria entering the extra luminal pathway
- Over use of the arm where the catheter is inserted
- Lack of effective ANTT

Signs and Symptoms of phlebitis:

- Redness and pain along the cannulated vein (refer to figure 32)
- Warmth
- Swelling of upper arm, shoulder and neck
- Induration along the vein
- Thrombosis may develop if early intervention for management of initial symptoms is not implemented

Management of phlebitis:

- Apply a warm compress over the affected area for 24-48 hours
- Rest and elevate the arm
- Administer analgesia if necessary
- Perform regular assessment of the insertion site and upper arm. Document findings
- Consider removing the PICC if symptoms do not resolve within 72 hours

Prevention of phlebitis involves:

- Appropriate catheter to vein ratio
- Good assessment skills and ANTT
- Effective securement device to prevent catheter movement
- Protective dressing
- Limiting movement of the arm
- Applying warm compresses over the cannulated vein for the first 24 hours post insertion

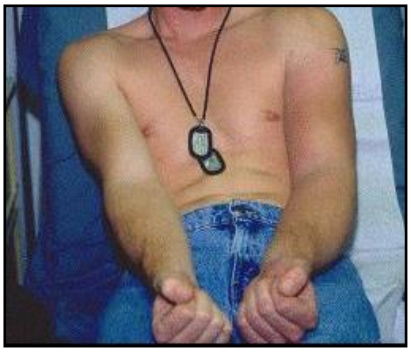


Fig.32: Phlebitis Source: Original Photo

PARENTERAL NUTRITION

Parenteral Nutrition (PN), formerly described as Total Parenteral Nutrition (TPN), refers to the intravenous infusion of a specialised nutrition solution of high osmolarity. This therapy may be used to provide nutritional support to a person whose gastrointestinal tract is either not functioning or is inaccessible and is unable to receive adequate nutrition with oral feeding, supplements or enteral feeding. PN consists of an all-in-one bag which is produced in the Pharmacy Sterile Production Unit and is referred to as a triple phase system.

PN requires a central vein, allowing rapid dilution of solutions to prevent phlebitis, pain and thrombosis. It is generally recommended that a CVAD be dedicated solely for the use PN *(CDC, 2012; Infusion Therapy Standards of Practice 2021).* This is to minimise the risk of infection or sepsis and prevents drug incompatibility. However, catheters with multiple lumens may be necessary for essential medical management especially where compromised patients are receiving complex therapies in addition to multiple blood sampling.

MINIMISING RISK OF INFECTION ASSOCIATED WITH PN

Due to the nutritional components of the PN solution it has the potential to create an environment that promotes the development of microbial growth. Within the hospital setting this risk of infection will increase as a result of:

- Malnutrition associated with immune suppression
- Graft versus Host Disease (GVHD) mucosa of alimentary tract
- Mucositis of the alimentary tract
- Neutropenia
- Hyperglycaemia
- Microbial colonisation and contamination of the catheter hub and surrounding skin.

ACTION: When PN is administered using CVADs with multiple lumens use the WHITE lumen. Attach a PN label to the tubing to identify that PN is being infused. To reduce the potential for catheter related blood-stream infection (CRBSI) always designate one lumen for PN (CDC, 2012,Infusion Therapy Standards of Practice 2021).

CONSIDERATIONS WHEN ADMINISTERING CONTINUOUS PN

CVADs used to deliver PN.

- The intended use of the CVAD and the intended length of duration for PN must be considered.
- Administration of PN only (Long Term or Short Term)
- PN in conjunction with other Parenteral therapy
- Blood sampling

Nursing considerations for administration of PN

- Always use a dedicated catheter lumen for PN. The WHITE lumen is used where multiple lumen catheters are in place - **No Additives to solution** (*except in Pharmacy under strict sterile conditions).*
- All PN solutions should be completed within the 24 hour period (*Refer to Dietician Prescription Form).*
- All administration sets and inline filters to be changed every 24 hours *(Refer to Volume D-Fluid & Medication Manual).*
- Always aim to maintain a closed system and don't discontinue or disrupt PN administration.

Haematology, Oncology and Child Health- Follow in-house policy which allows for:

- Personal cares and showering
- Patient's freedom from the infusion pump
- 'Time out' for the patient before re-connect
- Catheter maintenance
- Routine bloods can be taken during this time giving a more accurate picture of Biochemistry profiles

For further reading and information on PN refer to the references below

References:

- Ayers P, Bobo ES, Hurt RT, Mays AA, Worthington PH, eds. *ASPEN Parenteral Nutrition Handbook*. 3rd ed. ASPEN; 2020.
- Nutrition Support in Adults (2006). National Institute for Health and Clinical Excellence (NICE). www.nice.org.uk
- Infusion Therapy Standards of Practice 2021
- Infusion Nursing, An Evidence Based Approach Third Edition; Saunders 2010
- ESPEN Guidelines on Parenteral Nutrition: Central Venous Catheters. (2009). Clinical Nutrition.
- PN FAQ's Nutritional Support Team (NST). Updated May 2009. Canterbury DHB, Fluid & Medication, Volume 12
- Centre for Disease Control and Prevention (2012) Guidelines for the prevention of intravascular catheter related infection.

CATHETER SPECIFIC SECTION

PERIPHERALLY INSERTED CENTRAL CATHETER (PICC)

- Tunnelled
- Non Tunnelled

Tunneled Femoral Catheter (TFIC)

TUNNELED CUFFED CATHETERS

- HICKMAN®
- CICC (chest inserted central catheter)
- GROSHONG®

NON-TUNNELED CENTRAL VENOUS CATHETER (CVC)

IMPLANTED PORT – chest and arm

HAEMODIALYSIS /APHERESIS CATHETERS (tunnelled & non tunnelled)

PERIPHERALLY INSERTED CENTRAL CATHETER (PICC/TPICC)

A PICC is a central catheter that is inserted into a peripheral vein in the upper arm and passed along the veins until the tip resides at the cavoatrial junction(CAJ). The preferred vein for insertion is the basilic vein due to its size and is straighter offering a less tortuous route to the CAJ. Because the skin is generally dryer and less moist in this area,infection rates are lower.PICCs may also be tunnelled into the axillary vein.

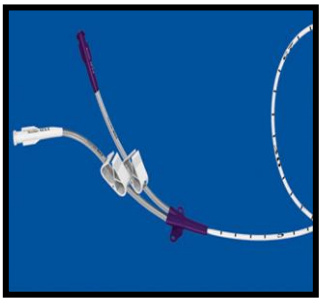


Fig. 33: A PICC
Source: Original Photo

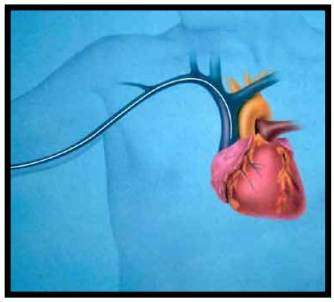


Fig. 34: Insertion pathway
Source: Unknown

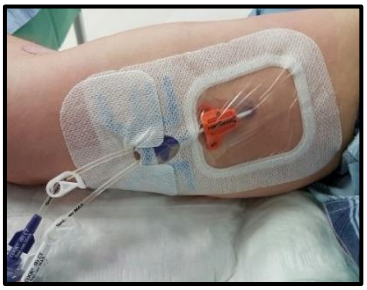
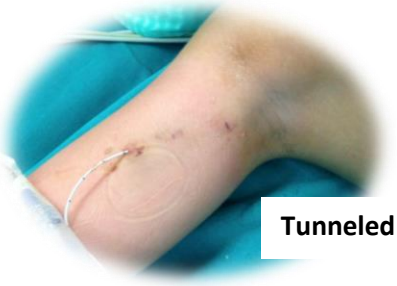


Fig.35: insertion site
Source:Original Photo



Tunneled PICC (TPICC)

Material and Specifications

A PICC is made of polyurethane generally measuring 50-55 cm in length with measure markings at 1 cm intervals along the catheter. PICCs inserted into adults in the CDHB are power injectable 4 fr or 5 fr.single or double and for children 3 fr or 4 fr may be used.

Configuration

5 fr 18 g Double lumen PICC- each internal lumen is independent from the other and both are 0.8 mL maximum

4 fr 18 g Single lumen PICC - internal lumen 0.8 mL maximum
3fr 20g Single lumen PICC - paediatric
Triple lumen PICCs are also available

Reverse taper i.e. from 4 cm to the purple wings it increases in diameter and is also trimmed to length

Flow rates:generally less flow rates than larger bore catheters due to length and diameter which limits treatment options

Dwell time: 6-12 months

Indications for use: Allows for the delivery of all types of medication/infustates but not complex IV treatment regimes

Management of a PICC

- Immediately post insertion keep the upper arm warm and encourage minimal movement
- Application of heat to the upper arm post insertion for 24 hours may be benifical in reducing mechanical phlebitis
- Heat dilates the vein improves blood flow and keeps the vein wall off the catheter (Simcock, 2007)
- No B/P cuffs, tourniquets or scissors are to be used on the arm where the PICC is indwelling
- DO NOT PLACE IV CANNULA IN THE ARM WHERE PICC IS INSERTED
- Protect the external portion of catheter from becoming wet especially during showering by covering the area with a plastic protection cover

Observe the insertion site and upper arm 8 hourly:

- always prior to administration of medications and IV fluids
- during pre and post access flushing
- during dressing changes
- check and document the external length measurement, securement method and dressing integrity each shift on the *'CVAD Management Form'.*

Assessment of early signs of complications can prevent premature removal of the PICC.

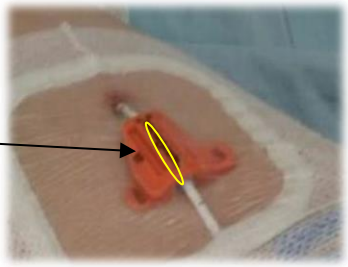
Dressing and Securement of a PICC:

- dressings are routinely changed on a weekly basis or sooner if compromised
- protect the external PICC site dressing by covering with Netlast® or Tubifast®. ***do not use bandages or Tubigrip® that can cause restriction to the upper arm.***
- always ensure the PICC is secured and stabilised to prevent migration

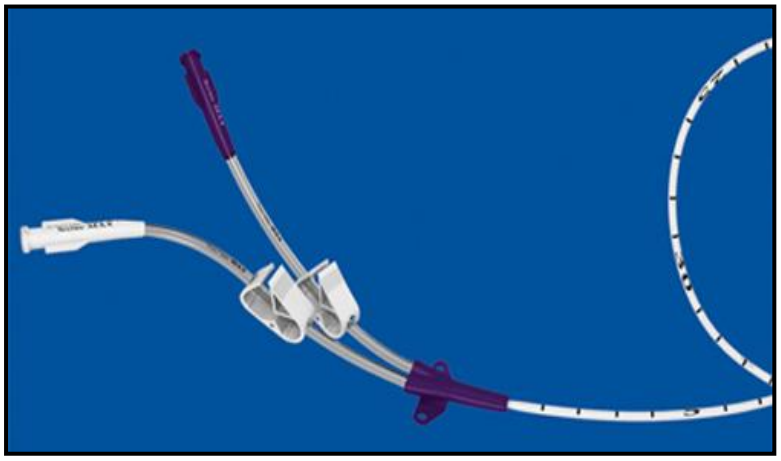
Securement methods used are SecurAcath™ or Surgical adhesive(selection dependent on required dwell time)Refer to section on catheter securement.

Measuring the external portion of a PICC

a SecurAcath measures 2cms lengthwise



ACTION: The correct external PICC measurement is taken from the insertion site to where the catheter joins the purple wings.(INS 2021). All PICCs are trimmed to length and are clearly marked at 1 cm intervals. This portion of the catheter from the 4 cm mark up to the purple wings increases in diameter as is travels towards the insertion site. This is referred to as a reverse taper and is a feature of a power PICC.



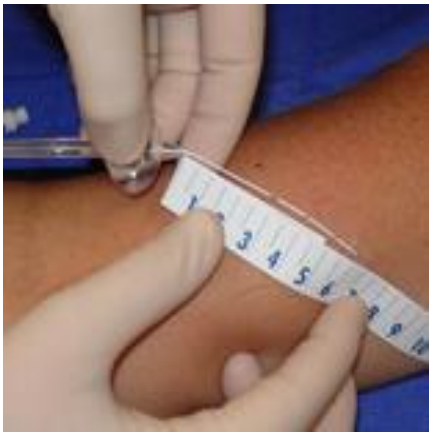


Fig 36 Peripherally Inserted Central Catheter Measuring external PICC length Source: Original

PICC Migration:
Migration and mal position can occur with PICC's.The external measurement is not always an indication that the PICC has migrated. Document your assessment in the *CVAD Maintenance Form*

IMPORTANT ACTION IF MIGRATION HAS OCCURRED -ADULT

INTERNAL Migration: where a PICC has migrated **IN 1-2cms** from the original position follow the steps below:

1. Pull the PICC back to its original mark as documented in CORTEX IR CVAD Insertion record and document your actions in the CVAD Management Form
2. Chest x-ray to confirm tip location
3. Do not use the catheter until Radiology has reviewed the chest x-ray and confirmed tip position

EXTERNAL Migration: -where a PICC has migrated **OUT 2cms** from the insertion site continue to use the PICC but monitor for any further migration.
If the PICC tip migrates out 4cm or more only isotonic solution can be used. If PN or known vesicant medication is required the PICC must be x-rayed for tip position first. If tip is not in an acceptable position, remove and replace if central venous access is required.
A CVAD that has that has migrated out cannot be re-inserted back into the vein.

Child Health PICC migration chart– refer pg 56-57

Click here **for PICC tip safety poster migration action steps**

CLICK HERE to view the PICC dressing video

Click here For PICC PATIENT INFORMATION BOOKLET

HICKMAN® TUNNELLED CUFFED CATHETER

The Hickman® catheter is described as a tunnelled cuffed catheter (see Fig.37 below). Tunnelling is a technique for placing a catheter segment of the catheter inside a subcutaneous tunnel to separate the vein entry site from the skin exit site. This method of insertion allows for lower infection rates and very long dwell times (INS, 2010).

The catheter has a dacron cuff which acts as an internal securement device. It becomes firmly attached by the growth of a connective tissue seal which stabilises the catheter. The internal jugular vein approach offers a sound alternative to the traditional subclavian surgical approach. With minimal complications it is now the generally prefered option with the catheter inserted in the right internal juglar vein because the venous course is less tortuous.

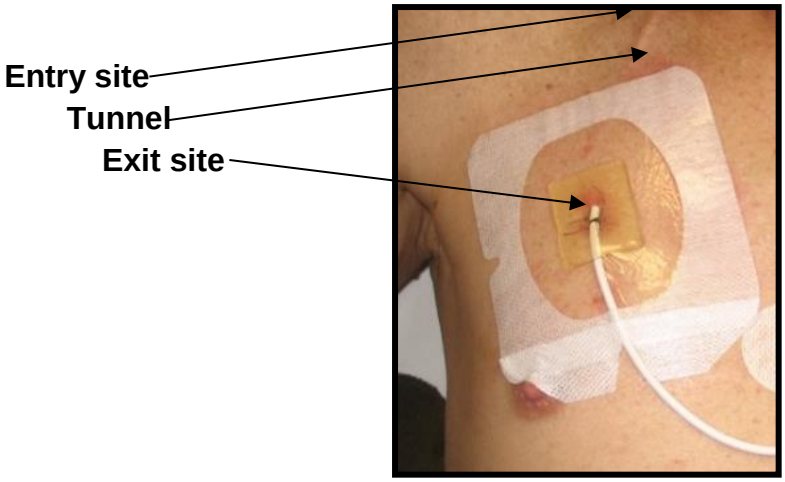


Fig. 37: The Hickman® tunnelled cuffed catheter Source: Original photo

Material and Specifications of Hickman®

The Hickman® catheter is made of silicone and is 90 cm in length (adult) 65 cm (paediatrics).
They are either single or multiple lumen and described as 'open ended' with all lumens exiting at the same point each providing an independent pathway (ref figure 41)
Each external lumen has a reinforced clamping sleeve to prevent catheter damage(*see image below*)
The CDHB use single, double and triple lumen configurations. The catheter also comes with a dacron cuff to maintain catheter stabilization once the sutures have been removed.

Configuration of Hickman®

Paediatric double lumen - 7fr 65cm in length – internal lumen white 0.8mL, red 1mL
Single lumen -10 fr 90 cm in length – internal lumen 1.3 mL.
Double lumen -10 fr 90 cm in length – internal lumen 1.3 mL.
Triple lumen -10 fr 90 cm in length – internal lumen 1.3 mL.
Catheter Tip to Cuff measurement = 54.6 cm. NB: this catheter is trimmed to length.

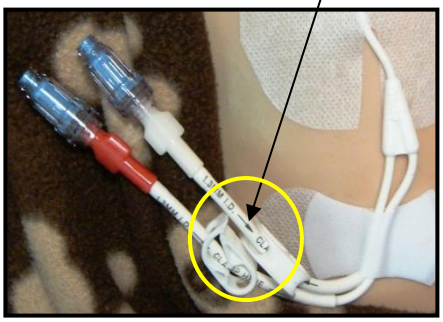
Flow Rates

Offers high flow rates

Dwell time

Is up to 2 years or longer if needed

Silicone has poor tolerance to pressure and can tear or rupture if excessive pressure is used. Always use syringes no smaller than 10 mL when flushing or administering medication. Clamps should remain on the Protective Clamping Sleeve of the catheter lumen/s to prevent tearing or damage to the silicone



Source: Original photo

Insertion

- Insertion is performed under local anaesthetic in IR by a Radiologist. Some patients may require sedation if they are anxious. The insertion is performed under Maximal Sterile Barrier (MSB) conditions.
- The patient has fluids only 4 hours prior to the procedure however if dehydrated then IV fluids may be given
- Remove chest hair on male patients using clippers prior to going to IR

In Child Health The Hickman® catheter insertion is carried out under a general anaesthetic

For haematology patients the coagulation screen for INR and the platelet count is checked and must be > $50x10^9$

Indications for use of a Hickman® catheter

- Long term management of all types of IV therapy, which includes complex treatment regiems, PN, bone marrow transplant.

Blood sampling from a Hickman® catheter

- The RED lumen is generally used for blood sampling from a multiple lumen catheter
  This is important because some drugs are given via the white lumen so as not to alter the integrity of the blood sample (refer to blood sampling section)
- Either the syringe or vacutainer method is acceptable.

Management of a Hickman® catheter

Click here to view practice videos

Following insertion, a sandbag is placed over the insertion site and tunnel area to apply pressure and minimise bleeding and haematoma. This is left in place for up to one hour. The patient should remain supine for 1-2 hours and physical activity should be restricted in the first 24 hours. The catheter has one suture around the **exit site (chest)** and one suture at the **entry site (neck);**

- The **exit site** suture is removed at 3 weeks
- The **entry site** suture is removed at 10 days

The catheter may be used immediately following insertion. Always assess the catheter patency before using it by flushing and aspirating to ensure flow is established.

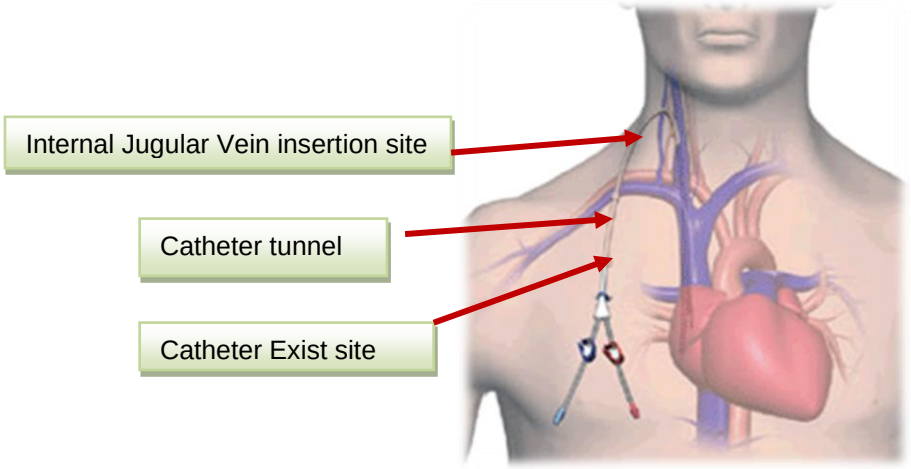


Fig.38: Hickman® catheter placement
Source: Unknown

Observation of the entry and exit site chest and neck area should be carried out at least 8 hourly when the catheter is not in use and:

- always prior to administration of medications and IV fluids
- during administration of cytotoxic agents
- during blood sampling
- during pre and post access flushing and routine maintenance flushing
- during dressing changes
- the exit site observed for cuff migration or curling of the catheter in the tunnel area

HICKMAN ® Catheter PATIENT INFORMATION BOOKLET - Click here

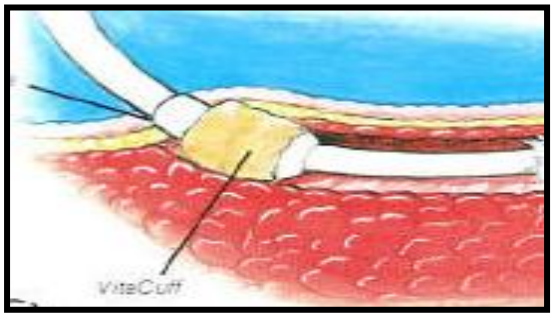


Fig.39: Dacron cuff in catheter tunnel
Source: Unknown

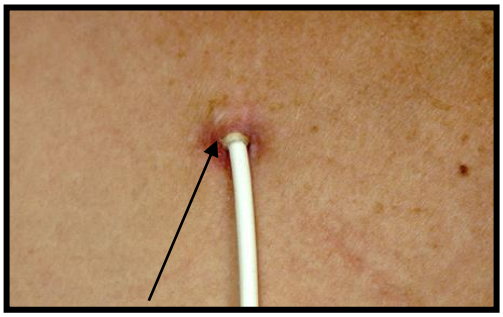
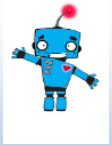


Fig.40: Dacron cuff migration at exit site Source: Original Photo

Dressing and Securement of Hickman® catheter

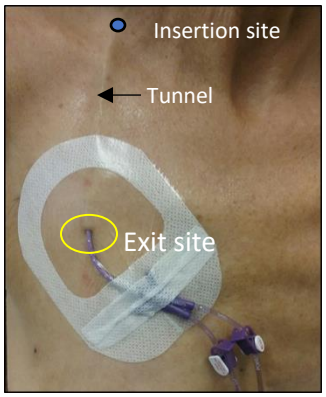
- Dressings are routinely changed weekly or if the dressing becomes compromised
- A Tubing Anchor is used to stabilize dual and triple lumen catheters, preventing accidental removal and catheter lumens above waist line
- Single lumen catheters are secured using a GripLoc®



ACTION: The dressing change is the same as for adults.
Securement of external lumens - the 'teddy bear' Tegaderm is generally used.
GripLoc® may also be used to secure external Hickman® catheter lumens

Fig.41: Single, double & triple lumen Hickman®
Source: Bard Access Systems Information Booklet

CHEST TUNNELLED CENTRAL CATHETER (CICC)



Source: Original

A CICC is described as a tunnelled cuffed catheter.
Tunnelling is a technique for placing a catheter segment of the catheter inside a subcutaneous tunnel to separate the vein entry site from the skin exit site. This method of insertion allows for lower infection rates and longer dwell times (INS, 2010).

The catheter has a Dacron cuff which acts as an internal securement device. The Dacron cuff sits in the catheter 'tunnel' approximately 2-3 cms from the exit site (where external lumens exit). It becomes firmly attached by the growth of a connective tissue seal which stabilises the catheter. The internal jugular vein approach offers a sound alternative to the traditional subclavian surgical approach. With minimal complications it is now the generally prefered option with the catheter inserted in the right internal juglar vein because the venous course is less tortuous.
A CICC is an ideal alternative to a PICC if the upper arm veins are compromised preventing access or treatment neccessitates the need for a longer term catheter.

Material and Specifications
The CICC is made of polyurethane and comes in 6 Fr double lumen or 5 Fr single lumen. It is purple in colour and is power injectable
The CICC is an 'open ended' catheter with all lumens exiting at the same point each providing an independent pathway for administration of medications & fluids.

Configuration
- Single Lumen – 5fr 58 cm in length
- Double Lumen – 6 fr 58cm in length - purple and white hubs
- The catheter is trimmed to an appropriate length for each patient.

Flow Rates
- Offers good flow rates

Dwell time
- Is up to 1 year or longer if needed

Insertion

- Insertion is performed under local anaesthetic (and sedation if required) by an advanced credentialed radiology nurse in IR. The insertion is performed under Maximal Sterile Barrier (MSB) conditions.
- The patient has fluids only 4 hours prior to the procedure however if dehydrated then IV fluids may be given
- Remove chest hair on male patients using clippers prior to going to IR

Indications for use

- Where upper arm vein access is not an option for a PICC insertion
- Long term management of all types of IV therapy
- Where CT is required (catheter is power injectable)

Blood sampling

- Where a double lumen catheter is in place the PURPLE lumen is generally used for blood sampling with the WHITE lumen reserved for PN and medications.
- Either the syringe or vacutainer method is acceptable. Use the BLUE TIP blood transfer device for this purpose and always ensure aseptic non touch technique is adhered to. If using the syringe method then use the PINK TIP Blood transfer device to transfer blood samples

Management

Essentially the same as for a Hickman® catheter.

To view practice videos *Click here* Refer to the CICC Information Form for further information.

The patient should remain supine for 1-2 hours and physical activity should be restricted in the first 24 hours.

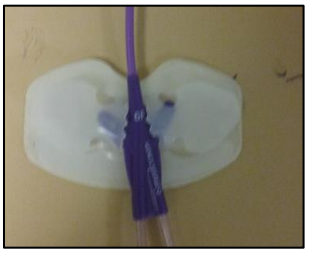
CICCs have ***surgical adhesive*** applied around the insertion site to address any post insertion bleeding and prevent bacteria entering the extra luminal pathway. **Engraftment of the cuff usually takes up to 3 weeks. A WingGuard is used to provide catheter securement until the cuff has engrafted into tissue. This usually occurs over 2-3 weeks. Once the WingGuard is finally removed it does not require replacing.**

The catheter may be used immediately following insertion. Always assess the catheter patency before using it by flushing and aspirating to ensure flow is established.

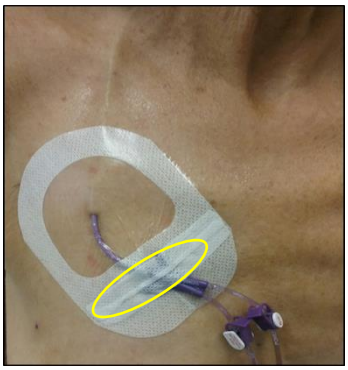
Ensure the external catheter is placed in such a way as to avoid downward pull on the catheter-See image below.

Either a Sorbaveiw or Tegaderm dressing may be used
(See images below)

Sources: Original



WingGuard securement



Wing Guard under dressing

KEY PRACTICE POINTS: **Click here** for CICC information sheet

- ***Whilst the adhesive is in place avoid cleaning directly over the insertion site because alcohol dissolves adhesive.***
- ***Start cleaning from perimeter of the adhesive and work outwards to avoid disturbing the surgical adhesive***
- ***Once the surgical adhesive comes away after 1-2 weeks. Usual cleaning over the area can resume as per protocol.***

Source: Original

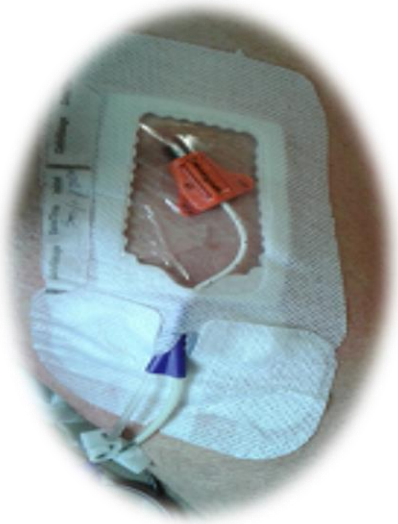
Removal of a CICC (ref to section on CVAD removal)

To be performed only by an RN who has a CVAD competency and is experienced in the procedure

1. Clean exit site a per policy- ref CVAD Resource Book
2. Support skin along the 'tunnel' with non-dominant hand
3. Grasp external portion of the CICC and give a firm tug to separate the cuff from the tissues.
4. Remove CICC slowly- put digital pressure on Internal jugular vein site as CICC exits the vein into tunnel
5. Cover the exit site with sterile gauze and apply pressure to exit site until any bleeding has stopped.
6. Cover the wound using a sterile opsite with dressing pad and leave covered until healing has occurred.

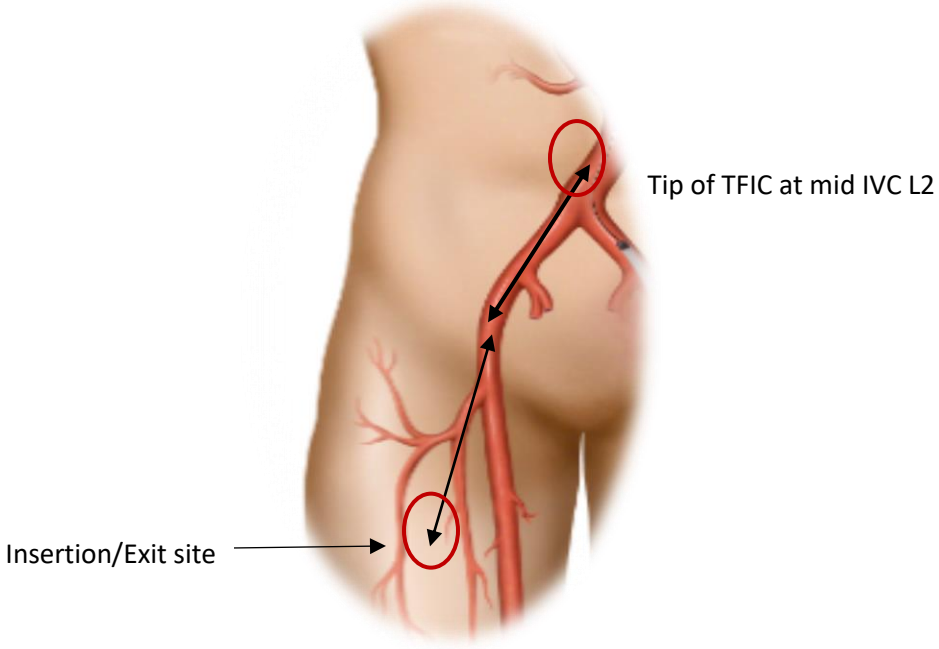
N.B. if the cuff does not dislodge and the CICC remains firmly adhered it will need to be removed by a medical officer using local anesthetic and a small cut down to free the cuff prior to withdrawing the catheter.

TUNNELED FEMORAL CATHETER (TFIC)



Standard PICC catheters are the ideal venous access device for a non-emergent access to the inferior vena cava (IVC). The indication for using this access is the presence of an obstruction of the superior vena cava or of both brachiocephalic veins (called superior vena cava syndrome), which eliminates the use any of the following veins (brachial, basilic, axillary, internal and external jugular, subclavian, cephalic, brachiocephalic) for achieving a central venous access.

The position of the tip inside the inferior vena cava is not considered central location, the 'central' location being the cavoatrial junction (CAJ) or the upper portion of the right atrium, according to most guidelines however, there is wide consensus that a catheter whose tip is in the mid portion of the inferior vena cava (above the iliac junction and below the renal veins) can be safely used for any kind of intravenous infusion.



Standard PICC catheters are suitable for this type of insertion, since their considerable length (50–60 cm) is very appropriate for the catheter length required when tunnelling into the femoral vein (at least 30 cm of intravascular length + at least 15–20 cm of tunnel)

Configuration

- Single Lumen – 5fr 58 -60cm in length
- Double Lumen – 6 fr 58-60cm in length -

Material and Specifications

The catheter is made of polyurethane and is power injectable

The catheter is an 'open ended' catheter with all lumens exiting at the same point each providing an independent pathway for administration of medications & fluids.

Securement: A SecurAcath is used to stabilise the TFIC (see image)

TFIC are suitable in the following situations:

- patients who have sustained upper torso burns or other sever injuries.
- patients hospitalised with COVID-19 who require a CVAD, this type of insertion eliminates the face to face contact health professionals usually have when managing upper chest CVAD placements.
- where vascular access in the arms and chest have been compromised due to frequent CVAD insertion resulting in vessel stenosis.

Key Points:

1. Management and care of a TFIC is the same as for any CVAD
2. Meticulous ANTT is essential to avoid bacterial migration along the extra and intra luminal vein pathway
3. Ensure the PDD hubs are thoroughly scrubbed and allowed to dry before accessing.
4. Due to the position of the insertion site on the upper thigh, mobilisation needs to be kept to a minimum to avoid catheter dislodgement and vessel irritation

NON-TUNNELED CENTRAL VENOUS CATHETER (CVC)

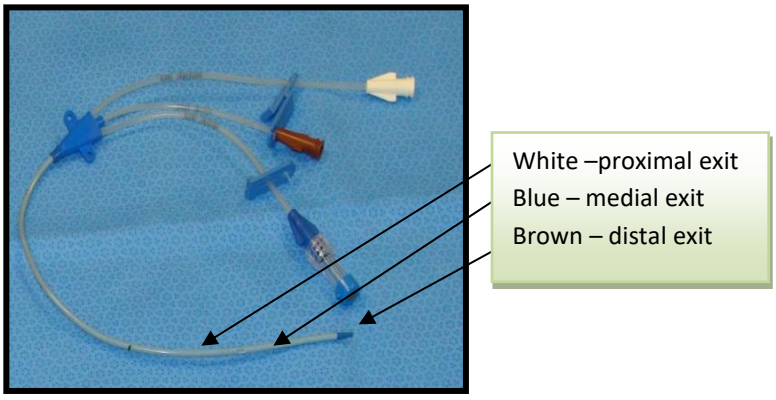


Fig. 42: Triple Lumen CVC Source: Original photo

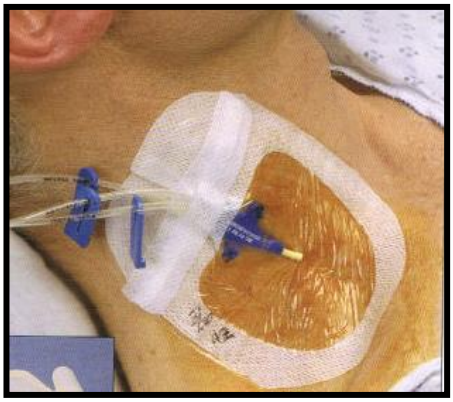


Fig. 43a: Triple lumen CVC
Source: Medical Illustrations CDHB

CVCs are non tunnelled short term CVADs (see figure 42 & 43a,). They can be jugular or subclavian. They are for short term use only and associated with a high infection rate compared to the other CVADs. This is due in part to the method of insertion, i.e. direct from skin into vein and the warm moist environment of the neck and shoulder area.

Material and Specifications of CVCs

They are made of polyurethane which is quite rigid, but softens once indwelling in the vein. Multiple lumen CVC's have exits at the distal, medial and proximal points and are clearly labeled on each catheter lumen

Configuration

- Single through to multiple lumen
- 7 fr - 8.5 fr (standard adult)
- 4 fr – 5 fr(paediatrics)
- Single lumen -16 -20 cm in length (adult)
- Multiple lumen – 16 -20 cm in length (adult)
- Other lengths available for paediatric patients

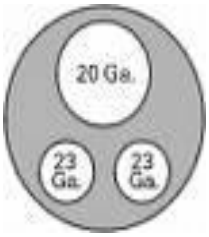


Fig.43b: Triple lumen CVC
Source: Unknown

Flow Rates

Deliver high flow rates due to its large lumen and short length

Dwell time

They are for short term access only from 1 and up to 3 days. Consider an alternative catheter if CVAD is still required.

Insertion

- Insertion of CVC's is carried under MSB by senior medical officers in ICU, CCU or by an Anesthetist in peri-operative. CVCs may also be inserted in the emergency department. CVADs radiographic tip confirmation is carried out prior to use.
- Either a jugular or subclavian approach may be used. The catheter is secured by a suture at the catheter wings

Non tunnelled CVCs carry a higher risk for insertion complication and infection

Indications for using a CVC

- Infusion of all types of medications, solutions, blood / blood products
- Fluid resuscitation, fluid assessment and accurate fluid management
- PN
- CVP monitoring and blood sampling

Blood sampling from a CVC

The BROWN lumen is used for blood sampling (refer to blood sampling section)

- Either the syringe or vacutainer method is acceptable. If the vacutainer method is used choose the BLUE TIP VACUTAINER for this purpose and always ensure aseptic non touch technique is adhered to. If contamination of the vacutainer tip occurs then a new vacutainer must be used
- If using the syringe method then choose the PINK TIP VACUTAINER holder to transfer blood samples

Management of a CVC

- Following insertion via the jugular vein the entry site is monitored for bleeding and swelling. If a haematoma develops it can cause compression of the sympathetic pathway resulting in drooping of the eye and absence of sweating which indicates Horner's syndrome. This is associated with jugular placement and upward tracking of the catheter
- The patient should remain supine for 1-2 hours and physical activity should be restricted in the first 24 hours
- The catheter is sutured on either side of the blue bifurcation and these remain in situ until the CVC is removed
- The catheter may be used immediately following X-ray confirmation
- Always assess the catheter patency before using it by flushing and aspirating to ensure flow is established

Observation of the the entry site chest and neck area is carried out at least 8 hourly when not in use and:

- always prior to administration of medications, PN, IV fluids
- during blood sampling
- during pre and post access flushing
- during CVP monitoring
- during dressing changes

Dressing and securement of a CVC

- *The dressing is changed if it becomes compromised*
- ADULTS - A BIOPATCH® or CHG dressing may be used

CVCs can pose a challenge to dress due to the insertion site location and the environment around the site. The correct method of dressing and securing these catheters plays an important part in minimizing complications.

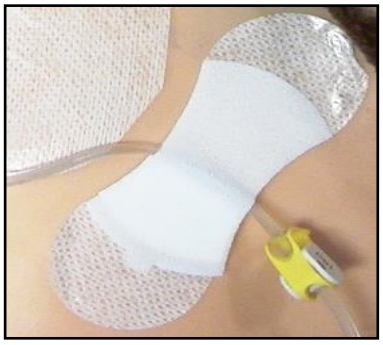


Fig.44: GripLoc® securement Source: Original Photo

IMPLANTED DEVICES–IMPLANTED PORTS-Adult & Child

An implanted port is a long term CVAD placed under the surface of the skin inside a surgically created pocket (see figures 45, 46 & 47). The pocket is usually created in the upper chest or upper arm.

Fig.45: Implanted Port
Source: Unknown

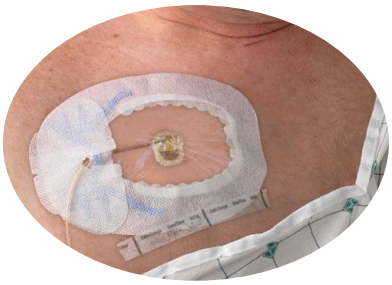


Fig.46: Implanted Chest Port
Source: Respiratory CDHB

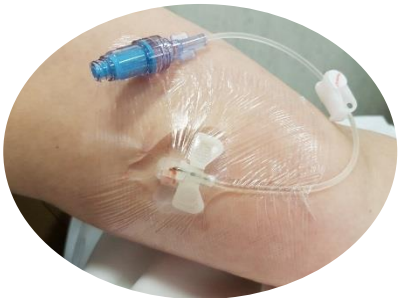


Fig.47 implanted upper Arm Port
Source: Original

The port is accessed with a non-coring needle which is passed through the skin and through the port septum using a 90 degree angle. Non coring needles have a deflecting point that helps to avoid damage to the septum increasing the life of a port (refer to figure 49).The non-coring needle is the only needle used for accessing a port and is referred to as a Huber® needle.
Using a 22-20 g non coring needle a port can be accessed approximately 2000 times before leakage starts to occur.
19 g non-coring needles are an advantage when administrating more viscose solutions or high flow is required. This includes administration of chemotherapy.

Fig.48: Implanted Ports

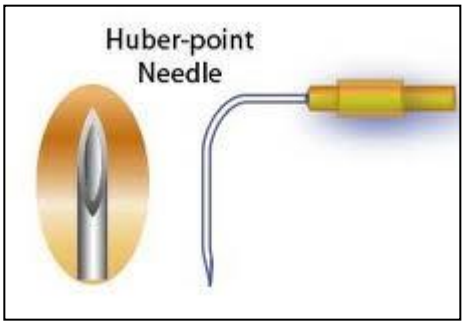


Fig.49: Non-coring needle for port access
Source: CDHB Patient Information Booklet

Material and Specifications of a Port

- Available in either polyurethane or silicone with single or double ports. The portal body can be round, square or triangular
- Consist of two parts – the body and the catheter
- 4-12 fr 125-225 cm
- Volume of reservoir ranges from 0.15 -1.3 mL

Configuration of a Port

- The portal body may be made of titanium, plastic. Titanium does not cause interference with MRI and is light weight
- Ports come in a variety of sizes, depths and shapes including power ports which are used when high pressure injectors are required
- High profile ports: are deeper
- Low profile ports: are shallower and have a smaller prime volume
- The portal body contains an internal reservoir covered with a septum made of dense, resealable material, usually silicone
- The width of the septum ranges from 6.6 -17.8 mm
- The catheter is made of a radio-opaque silicone or polyurethane. It is also designed to reduce the incidence of fibrin sheath/thrombus formation
- The base of the port has suture holes around the circumference to enable the portal body to remain stable
- The outlet stem exists from the base of the portal body and provides the attachment for the catheter

Some brands have pre-attached catheters while others are attached during the insertion procedure.

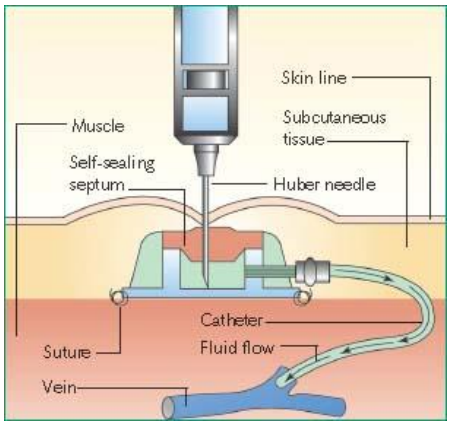


Fig.50: Profile of an Implanted Port

Source: Unknown

Flow Rates

Flow rates depend on size of the needle used to access the Port.
19 g -1680 mL/hr; 20 g – 960 mL/hr; 22 g -300 mL/hr

Dwell time

Designed for long term dwell the port can remain in place for 5 -10 years

Insertion of a port

The choice of port site is discussed with the patient and includes physical characteristics, body image concerns, cosmetic factors and life style. Implantation of Ports is carried out by a vascular surgeon. This may either be under general anaesthetic or sedation if the patient is respiratory-compromised.

- The port and components are placed under the skin inside a surgically created pocket in the upper chest area
- The port is sutured to the underlying fascia with non-absorbable sutures
- The catheter is inserted into the axillary-subclavian vein either at, or lateral to the mid-clavicular line. This prevents the catheter occluding with certain arm movements and is referred to as 'Pinch off Syndrome'
- The port is not placed too deeply under the subcutaneous tissue making it easier to palpate and access
- The insertion site is sutured usually with dissolvable sutures which do not require removing

Indications for use are

- patients with chronic disorders requiring long term access e.g. cystic fibrosis,
- the infusion of all types of medication and solutions
- the administration of blood /blood products
- for blood sampling
- for IV contrast via pressure injectable port (Power Port®) in CT

Blood sampling from a Port (also refer to section on Blood Sampling p.36-40)

- Always perform hand hygiene and use an aseptic technique for preparing equipment
- The syringe or vacutainer method is acceptable
- If blood tests for aminoglycosides levels or coagulation profiles are required, flush port first with 20 mL sodium chloride 0.9% prior to blood sampling then aspirate blood discard sample then take required blood tests (Boodhan et al,2006)
- Where BLOOD CULTURES are required DO NOT FLUSH THE PORT. Use the initial discard blood for the blood culture specimens
- Following blood sampling the port is flushed with 20 mL 0.9% sodium chloride
- "Lock" the port using the locking tables Guide below – Adult/Child

ADULTS: Maintaining Port Patency

Adult Ports are **locked with 10mL 0.9% sodium chloride** using ASAS Routine

Aspirate blood	3-5mL and discard syringe
Saline flush	10 mL sodium chloride 0.9% pre-filled syringe
Administer	Medication, IV fluids, blood products
Saline Post Flush/lock	10 mL sodium chloride 0.9% pre-filled syringe using pulsating flush *(use 2x 10mL following blood sampling or blood product administration)* ***When Port not required lock every 3 months.***

CHILDREN: Maintaining Port Patency using ASAS Routine

Aspirate blood	3-5mL and discard syringe
Saline pre-flush	10 mL sodium chloride 0.9% pre-filled syringe (Follow chart related to age group volumes)
Administer	Medication, IV fluids, blood products
Saline post flush/lock	10 mL sodium chloride 0.9% pre-filled syringe using pulsating flush (consider appropriate flush volume for age following blood sampling or transfusion ref to CH locking chart P 31) **When Port not required lock monthly.**

Port needles have an extension set with clamp and MaxPlus® positive displacement device which delivers a positive bolus into the port on disconnection of the syringe

Locating the Port:

To access the port the septum must be located by palpation. Triangulate the port between the thumb and the first two fingers of the dominant hand. Refer to figure 52.

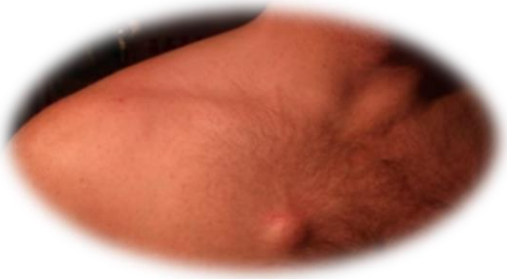


Fig.51: Port visible under skin
Source: Respiratory Department CDHB

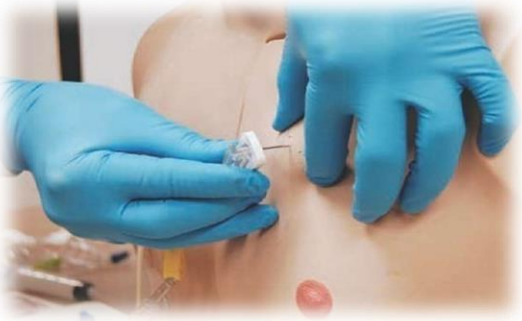


Fig.52: Triangulating Port Source: Child Health CDHB

Management of a Port:

Prior to accessing a port, a topical anesthetic cream is applied one hour prior to the procedure (adults and children).

Correct needle selection is an important factor in preventing complications.
The size and length of needle used to access a port will depend on the type of infusion and how much tissue lies over the port.
a. If the port is easily palpated and visible under the skin, then a ¾" - 1" needle is appropriate.
b. If the port is well covered by tissue and not visible, then a 1" - 1½" needle is preferred.


Selection of the correct needle length will prevent complications of inadvertent displacement and extravasation of Infusates into surrounding tissues

Extension Set Change for a Port

- If an additional extension set with clamp is required, this is connected aseptically at the time the needle is inserted and this is considered part of the catheter remaining in situ until the weekly needle change.
- Replacement of the extension set is only required if it becomes compromised i.e. worn from over clamping, leakage, contamination or use of blood products.

Power Injectable Ports

- Allow for diagnostic CT using high pressure injectors. A power injectable port needle and extension tubing must be used. Always refer to the patient's clinical record to identify if a power port has been inserted into the patient.


Non power injectable ports SHOULD NEVER be used for CT using

Table 9: ACCESSING THE PORT – INSERTING THE NEEDLE

1. Palpate location of port and apply local anesthetic cream (if indicated) to area leave for 60 minutes. For children use coolsence®. Leave for 10 seconds
2. Prepare equipment
3. 1x 10 mL sterile standard syringe with 5 mL sodium chloride 0.9%
4. 2x 10 mL pre-filled sodium chloride 0.9% syringes
5. Attach a MaxPlus® PDD device to the extension set and non-coring needle and prime with 10 mL sterile sodium chloride 0.9% syringe (leave syringe attached)
6. Use non- sterile gloves to remove dressing and use gauze to remove local anesthetic cream
7. Hand hygiene - and aseptic procedure using sterile gloves
8. Clean port site with Chlorhexidine 2% & alcohol 70% swab stick using a vigorous circular or grid motion
9. Allow to dry for 30 seconds
10. Repeat the above steps using other side of swab stick
11. Locate port septum by palpation
12. Triangulate port between thumb and first two fingers of non-dominant hand (refer figure 54)
13. Insert needle at a 90° angle aiming for the center of the port septum located between your fingers
14. Advance needle through skin & port septum until reaching the base of the port reservoir(fig.54)

Fig.53: needle through port septum Source: Unknown

15. Using the syringe attached to extension set flush Port with 10mL sodium chloride 0.9% & check for presence of pain or swelling.
16. Aspirate 3-5mL of blood to verify correct needle placement and catheter flow then **discard** syringe.
17. If blood samples are required, take them at this point. ***NB: If blood cultures are required use the discard sample for this purpose (refer to the section on blood sampling p36-40)***
18. If not commencing an infusion, administering drugs or taking blood samples - flush/lock with 10mL 0.9% sodium chloride ***(CH ref to age related volumes Locking chart P31)***
19. Place gauze under wings of needle (if required) and cover the needle with a semi permeable occlusive dressing leaving the extension set with access device exposed
20. Secure extension set with Griploc (if required)

Table 10: DE-ACCESSING THE PORT - REMOVING THE NEEDLE

1. Ensure patient is positioned comfortably **2.** Hand hygiene **3.** Prepare equipment **4.** 1x10 mL pre-filled sodium chloride 0.9% syringe **5.** lx 10mL sodium chloride 0.9% for locking port (***CH ref to age related flush volumes locking table P31)***
6. Hand hygiene **7.** Apply non-sterile gloves **8.** Saline flush using 10 mL pre-filled sodium chloride 0.9% syringe **9.** Disconnect syringe to initiate positive displacement via the MaxPlus® access device ***10. Ref CH locking table for age appropriate flush volumes***
11. Remove dressing – do not contaminate needle entry site **12.** Clean needle site with Chlorhexidine 2% & 70% alcohol stick **13.** Allow to dry – 30 seconds **14.** Stabilize port with two fingers **15.** Remove needle **16.** Apply a sterile bio-occlusive dressing with absorptive pad over the needle exit site **17.** Remove non-sterile gloves **18.** Hand hygiene
19. Document procedure & variances in patient's CVAD Insertion & Maintenance Form

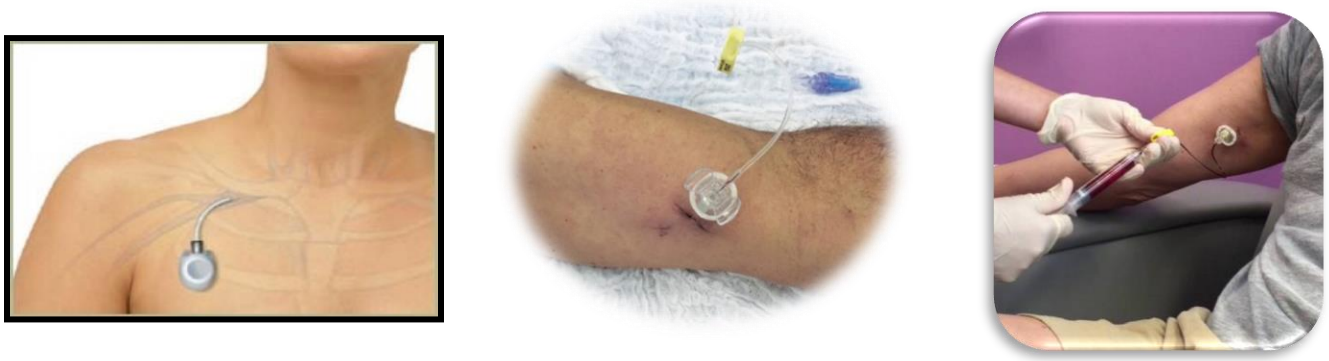


Fig.54: Chest & Arm Port placement

Source: Unknown

SELECTING THE CORRECT NEEDLE LENGTH AND SIZE

When choosing the appropriate needle length to access a child's Port it is important to have knowledge of the following:

1. Correct technique for palpating for the port
2. Depth of the port profile
3. Thickness of subcutaneous tissue covering the port

This assessment then allows for the selection of the appropriate length needle.

The range and size of needles that will suit the child's needs are easy to use and sit flush to child's skin. The winged material is soft and should not cause any increased risk in pressure injury formation.

Surecan® winged infusion sets come in needle length sizes 12mm up to 30mm. These are non-safety needles

The images below show suitable needles for accessing the Port

Surecan®11 safety Port needles. Source: B-Braun

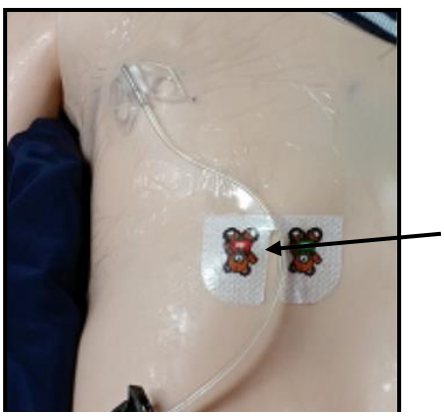


Fig 55 Child health: method of securing the Needle extension set

IMPLANTED PORT COMPLICATIONS

Complication may affect the implanted port. Many of these interventions are medical responsibilities and the appropriate medical staff should be notified if any of the following complications are suspected.

Total or partial occlusion of a Port:

- Check needle position
- Portal or catheter movement
- Catheter kinking / clamped catheter
- Fibrin sheath formation

Interventions

- Check needle position is fully advanced through the portal septum making contact with the chamber
- Check patency by flushing
- Change needle if incorrect position is suspected
- Using a sterile 10 mL syringe with sodium chloride 0.9%, gently alternate between aspiration and irrigation to ascertain blood return. Do not use excessive pressure as this can cause catheter rupture or force a clot into the circulation
- Have patient reviewed by doctor and/or nurses specialising in the care of ports
- X-ray-dye studies to confirm location of port and catheter
- If port and catheter have become separated, surgical intervention is required. DO NOT USE PORT
- If the catheter tip is against the vein wall, but the port is flushing freely, continue to use
- If occluded follow the *Catheter Occlusion Algorithm* in section on occlusion

Pain on flushing of a Port could indicate the following:

- separation of the catheter from the portal body
- needle dislodgement from the portal body

Prevention of incorrect needle access or placement:

- always ensure that the needle is adequately secured after accessing
- do not tilt, rock or pull on needle when port is accessed

Symptoms of incorrect needle placement are:

- chest, shoulder or back pain with infusion of fluids or medications
- signs of extravasation such as swelling, pain and redness around the port

Interventions required if pain is experienced during infusions

- stop the infusion/flushing immediately. Do not remove needle. Notify medical team.
- treat extravasation as per medical team
- re-access the port (if appropriate)

Infection of a Port:
Implanted ports may become infected at the insertion site, port pocket, inside the catheter, or along the catheter tunnel track. Infection can be introduced when accessing the port, withdrawing blood samples or by contaminated Infusates.

Symptoms of an infected Port are:

- redness, swelling or tenderness over port site and tunnel track
- fever
- rigors during flushing of port

Prevention of a Port infection requires the following:

- effective hand hygiene
- aseptic technique during all port procedures
- changing extension tubing weekly
- maintaining dressing integrity – keep dry, change if it becomes compromised
- changing the needle and dressing weekly

Interventions for a Port infection include:

- prescribing antibiotic therapy – medical orders
- removing the port if indicated

📖 For further reading on refer to the 'Complications Section'

The IMPLANTED PORT **ADULT** PATIENT INFORMATION BOOKLET

. Click here to obtain a copy.Print off as required

GROSHONG® TUNNELED CUFFED VALVED CATHETER

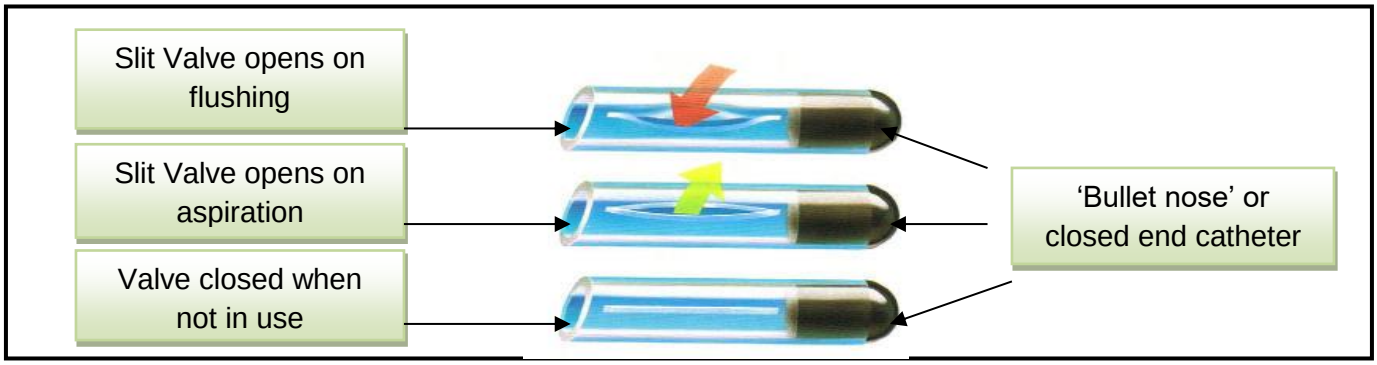


Fig.55: GROSHONG® TUNNELED CUFFED VALVED CATHETER Source: Bard Access Systems Information Booklet

HOW TO USE THE GROSHONG® CATHETER

1. Always use a 10 mL syringe for flushing or aspirating. The catheter is designed to be flushed with sodium chloride 0.9% only.
2. The flush is delivered as a FIRM LAMINAR push which OPENS the catheter valve. *This is the correct flushing technique for Groshong® catheters*.
3. Firmly aspirate using a syringe to open the valve and withdraw blood.
4. On disconnection of syringe or IV administration set the valve will close and remain in neutral position.

ACTION: Vigorous laminar flushing is recommended for the Groshong® due to its design. This ensures the valve opens and closes correctly otherwise the valve can become incompetent causing leakage of blood into the lumen

DO NOT USE POSITIVE DISPLACEMENT DEVICES on this catheter. Positive displacement devices keep the valve open causing blood to backflow through the valve which becomes incompetent. Blood can be observed in the catheter tubing when this occurs (Mayo 2000)

Always use a standard SmartSite® access device (INS 2016)

Troubleshooting a Groshong® catheter

- Always access the catheter as in steps 2 & 3 above. This ensures the valve is left in neutral position after syringe disconnection.
- Be aware that clots can form along the valve and cause leakage of blood back into the catheter. If this occurs, it can be seen along the external catheter.
- If occlusion from a thrombus occurs in the valve compromising flow the use of alteplase will be necessary to salvage the catheter.
- The method used for declotting a Groshong® is the same as other CVADs. The 'overfill technique' is be used by slowly instilling the alteplase to ensure the clot is not disturbed. Clots usually form on the external edge of the valve occluding flow.

HAEMODIALYSIS AND APHERESIS CATHETER

Haemodialysis and apheresis catheters are made of polyurethane and are described as being high flow and large bore with a 'hard wall' to prevent the catheter collapse during high blood flow procedures (see Fig 56, 57 & 58). This is an important consideration when procedures can last for many hours.

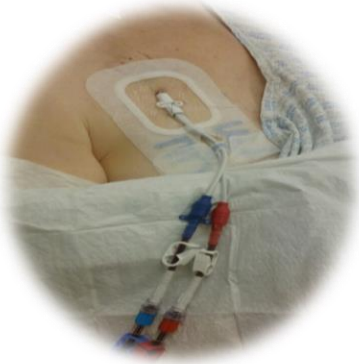


Fig. 56: Tunnelled Apheresis Catheter Source: Original

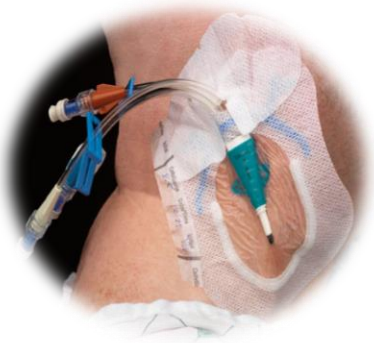


Fig.57: Jugular placement
Source: Acute Dialysis CDHB

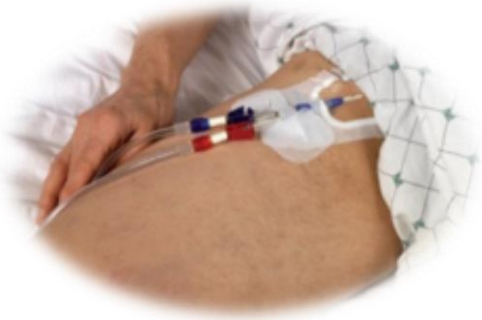


Fig.58: Femoral placement
Source: Original

Configuration of Haemodialysis /apheresis catheters

- The catheters are usually 13-16 g. They are shorter in length and less flexible than other catheters and are 20 -30 cm long
- The catheters come in double lumen or triple lumen with colour coded hubs

Flow rates of Haemodialysis /apheresis catheters

- These catheters offer very high flow rates necessary to process large volumes of blood during dialysis or apheresis

Dwell time of the dialysis/apheresis catheter

- These catheters are designed for short term use only (2-5 days) and are inserted to provide appropriate treatment options

CATHETERS USED BY AUTHORIZED PERSONNEL ONLY

ACUTE / PERMANENT TUNNELED DIALYSIS CATHETERS: These are strictly reserved for dialysis, primarily because of many problems associated with occlusion and the increased risk of catheter related infection. These catheters are inserted mostly into the jugular and may be non-tunneled or tunneled. Personnel authorized to access and manage these catheters are DIALYSIS NURSES, TECHNICIANS and trained WARD14 STAFF.

ICU *DIALYSIS CATHETERS:* are inserted into the femoral vein and used for continuous renal replacement therapy. They are strictly reserved for ICU STAFF who perform this procedure.

APHERESIS CATHETERS: These are used strictly for therapeutic procedures such as therapeutic plasma exchange and peripheral blood stem cell harvesting for bone marrow transplant. They are inserted into the jugular, or femoral vein.
Personnel authorized to access and manage these catheters are the NZ REGIONAL BLOOD SERVICE REGISTERED NURSES.

Management of apheresis catheters
This group of catheters is problematic in that they are difficult to secure and maintain because of their rigidity and area of insertion. Their size makes them more uncomfortable and restricts patient movement.
The site can bleed easily making it difficult to keep the dressing clean, dry and intact.
A BIOPATCH® is placed around the catheter at the insertion site and a bio-occlusive transparent dressing is applied over the site.
Femoral vein placement requires the patient's activities to be restricted to prevent bleeding at the insertion site and /or perforation of the femoral vein.
Removal: slowly withdraw catheter with dominant hand, while holding sterile gauze over exit site.

- Cover insertion site with sterile gauze, applying finger pressure to the site for five minutes
- Cover site with an air tight sterile occlusive dressing with dressing pad *to seal the skin-to-vein tract and reduce the risk for air embolus* for at least 24 hours.
- Patient should remain in supine position for 30 minutes following procedure
  BMTU and CHOC refer to in-house policy regarding platelet count

 Unauthorized personnel who access these catheters increase the risk for complications such as occlusion and infection, compromising the catheter dwell and the patient's treatment. The catheter lumens are labelled with a RED drug label to indicate that the 'locking solution' is instilled into the catheter. The catheter lumens are then wrapped together in gauze.

CATHETER 'LOCKING' SOLUTIONS:
ACUTE /PERMANENT TUNNELED DIALYSIS CATHETERS are 'locked' with one of the following to fill the volume of the catheter lumens. The fill volume is written on the catheter lumens.

- Heparin 5000 units
- DuraLock-C™
- Antibiotics

ICU DIALYSIS CATHETERS are 'locked' with the following:
Heparin 5000 units and the volume is indicated on the catheter lumens

APHERESIS CATHETERS are 'locked' with the following:
Heparin 5000 units 1.3 mL into each lumen

 Dialysis and Apheresis catheters carry a high risk for infection. Always ensure they are managed appropriately and removed as soon as they are no longer required

Appendix. **Guidelines for Administration (Adults)** DuraLock-C™ (Trisodium Citrate 46.7%)

Description and Action:

DuraLock-C™ 46.7%. Single use 3mL syringe containing 2.5mL of solution, packs of 2 with a red and blue cap (no difference between either syringes.)

DuraLock-C™ 46.7% is a catheter lock solution for central venous catheters to prevent coagulation by chelation of ionized calcium. It can be used as an alternative to heparin where heparin is contraindicated. pH adjusted to approximately 5.0-8.0. DuraLock-C™ if flushed through the CVAD and into the blood stream during the locking process typically metabolises to bi-carbonate in the liver and muscles within 10 minutes and has limited systemic effect.

Administering the Lock using the guide underlined below

1. Before administering DuraLock-C™ 46.7% explain to the patient that they may experience slight temporary side effects. (see below)
2. Following the administration of medicines, IV fluids, blood products and blood sampling flush catheter lumen/s with appropriate volume of 0.9% sodium chloride as per protocol
3. 46. DuraLock-C™ 46.7% should not be diluted. Any dilution decreases the overall effect of the lock over the inter-dialytic period.
4. IMPORTANT: instill DuraLock-C™ 46.7% lock into the catheter lumen/s SLOWLY TAKING 8-10 SECONDS

This ensures that the solution does not 'shoot' out of the end of the catheter lumen/s into the vein, but gently pushes the flush solution/blood back down the catheter lumen/s into the vein, leaving DuraLock-C™ *46.7% only in the lumen/s*
Document the volume administered making note of the volume instilled at the point when the patient reports a tingling sensation.

Side-effects:
The clinical (harmless) side-effects experienced by some patients, which are described and mentioned from clinical practice are:

- Parageusia (metallic taste in the mouth)
- Paresthesia (tingling in the fingers)

These side-effects disappear within 1 minute and are a sign that the catheter lock volume exceeded the internal volume of the catheter leading to the extra volume of DuraLock-C™ **46.7% passing out of the distal tip of the catheter into the bloodstream. Decreasing the volume by 0.1 mL for the next instillation will solve the problem in most cases. If the patient still complains, decrease the lock volume again by 0.1 mL, until the patient does not report any further side effects. NOTE**: Decreasing the volume too much will mean that the catheter does not become completely full leaving a space at the lumen tip for blood to enter and clot. It is better therefore for the patient to have slight side-effects that pass very quickly than a thrombotic catheter occlusion.

TROUBLESHOOTING:

Unable to aspirate DuraLock-C™ 46.7% from CVAD: DuraLock-C™ 46.7% *can slowly be injected into the patient's blood stream.* ***It is important to inject slowly taking 10-20 seconds.*** *If both lumens cannot be aspirated, it is advised that you inject the lumens separately leaving several minutes between injecting the first and injecting the second. There is a possibility that the patient will mention the side-effects as described above.*

Parageusia & Paresthesia: *These side effects can be reduced by giving the patient a glass of milk or a calcium effervescent 1g' tablet in water (which is in Med Chart).*

Discolouration of catheter lumens: *The action of citrate as it chelates clots and biofilm may result in a pink, red or brown colorization of the external catheter lumens, especially in those catheters which are in-situ for a relatively longer period of time. This is quite normal.*

Altered blood sodium results: *It has been found on rare occasions that residual* DuraLock-C™ *46.7% left in the catheter after the solution has been aspirated can affect the patient's blood analysis in regard to sodium levels.*

To avoid blood sample contamination always flush the catheter with 10-20mL 0.9% sodium chloride, aspirate discard blood as per protocol then take blood samples. (refer blood sampling section CVAD Resource book)

For Further Reading on CVAD

Child Health Volume Q. Child Health Policy & Procedure Manual Central Venous Access Devices Management in Children & Young People

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