Peripherally Inserted Central Catheter Insertion

An Evidence Based Insertion Package
For Registered Nurses

Radiology Department
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February 2012
Updated May 2014

Review date: 2015
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INTRODUCTION

The Peripherally Inserted Central Catheter (PICC) belongs to a group of catheters referred to as Central Venous Access Devices (CVAD). When patient assessment indicates the need for prolonged Intravenous (IV) therapy a placement of a PICC can be used for the administration of multiple medications, cytotoxic agents, parenteral nutrition (PN), blood products and drawing of blood samples.

PICCs are invaluable for patients with multiple and complex needs, and for those who may have venous access challenges. In both the acute and community setting they provide an immediate and reliable route for intermittent and continuous intravenous administration.

PICCs are inserted under ultrasound guidance into an upper arm vein using a Seldinger technique.

All types of CVAD can be associated with catheter related blood stream infection (CRBSI) therefore interventions to reduce the rate of CRBSI are especially important in the insertion, management and care (Maki, Kluger, Crnich, 2006).

A safe and successful PICC insertion is reliant on the inserter being well trained and having knowledge of a comprehensive assessment process, anatomy and physiology, documentation process and risk management.
PROFESSIONAL ACCOUNTABILITY

Registered Nurses (RN) must meet the standards outlined in the ‘Competencies’ for entry to the Register of Comprehensive Nurses (Nursing Council of New Zealand [NCNZ], 2000). This applies to all nurses currently practicing.

**Definition:** Competence is the combination of skills, knowledge, attitudes, values and abilities that underpin effective performance as a nurse (NCNZ, 2000)

With increased scope of practice comes increased professional accountability established through the competencies described below:

- Demonstrates initial and ongoing knowledge and skills for specific expanded practice role/activities through postgraduate education, clinical training and competence assessment.
- Participates in the evaluation of the outcomes of expanded practice, e.g. case review, clinical audit, multidisciplinary peer review.
- Integrates and evaluates knowledge and resources from different disciplines and health-care teams to effectively meet the health care needs of individuals and groups.

Nurses who are practising in an expanded scope are expected to declare this when they apply for the Annual Practising Certificate and to demonstrate and document how they meet these competencies. They will be assessed as part of a professional development employer’s credentialing programme and as part of the Council’s recertification audit.

An expert nurse is one who works within a specific area of practice incorporating advanced knowledge and skills.

The pre-requisites for Registered Nurses who wish to be instructed in PICC insertion are:

1. Work in radiology
2. Have achieved certification in venepuncture, peripheral cannulation and CVAD
3. Are considered by their peers as an expert in peripheral cannulation
4. Have 2 years experience in the management and care of central lines
5. Be competent working in the Interventional Radiology (IR) suite.
6. PDRP Proficient level or above.
PERIPHERALLY INSERTED CENTRAL CATHETER (PICC) INSERTION CERTIFICATION

The inserting of PICC and Midline catheters requires expert knowledge and skill and is described as advanced practice for Registered Nurses.

Components of PICC Insertion Certification:

1. Current Peripheral IV Cannulation certification
2. Current CVAD certification (non Implanted Devices)
3. PICC Nurse Insertion certification which includes Practical Skills Assessment

Instructions for PICC Insertion Certification:

1. Complete the PICC Insertion Package
2. Complete the Theory Test (100% pass is required)
3. Insert seven PICCs under the supervision and instruction of a certified PICC Nurse Inserter assessor
4. Complete the Practical Skills Assessment component by performing an additional three PICC insertions under observation of the PICC Nurse Insertion assessor.
5. On completion of the PICC Nurse Inserters’ Certification the evidence is sent by the Radiology CNM to the Professional Development Unit (PDU) and the nurse’s name is entered onto the CDHB PICC Nurses Inserters Competency data base. Eight hours for professional development will be credited and be entered onto the RN’s individual training data base
6. Re-certification is required every three years which includes one observed PICC insertion. This process will be managed by the Charge Nurse Manager Radiology. Four hours for
Professional development will be credited and entered onto the RN’s individual training database.

LEARNING OBJECTIVES

This comprehensive Self directed Learning Package is designed to assist the RN to develop critical thinking skills and demonstrate knowledge in the assessment and insertion of PICCs and Peripheral Midline Catheters.

At the completion of the PICC Nurse Insertion competency the RN should be able to:

- Describe patient assessment and consent process
- Select the appropriate PICC/Midline catheter for insertion
- Describe the anatomy and physiology of veins in relation to the insertion of a PICC/Midline catheter
- Describe factors affecting blood flow and the impact on PICC line placement
- Identify and select an appropriate vein for insertion in the upper arm
- Describe the principles of infection prevention and control
- Describe Maximal Sterile Barrier (MSB) in relation to PICC/Midline insertion
- Demonstrate knowledge in the use of the ultrasound probe and fluoroscopy
- Demonstrate correct technique for accessing the selected vein and inserting the catheter
- Demonstrate knowledge of correct catheter tip position on X-ray using the correct landmarks of the heart, carina and 4th rib
- Identify complications and describe prevention and intervention of each
- Demonstrate correct dressing and securement
- Discuss contra indications of PICC/Midline insertion
- Discuss reasons for insertion
- Describe accurate documentation
- Participate in quality assurance initiatives and audit of PICC insertions.

Throughout this package are ‘ALERTS’ ‘ACTIONS’ and ‘FURTHER READING’

This symbol indicates ‘important alerts’
DEFINITION OF A PICC AND MIDLINE CATHETER

PERIPHERALLY INSERTED CENTRAL CATHETER:

A Peripherally Inserted Central Catheter (PICC) is described as a central line that is inserted into a peripheral vein in the upper arm and advanced along the vein until the tip resides in the lower 1/3 of the superior vena cava (SVC). The preferred vein of choice is the right basilic because it is larger, straighter and offers a less tortuous route to the SVC (Infusion Nurses Society, [INS] 2006).

PERIPHERAL MIDLINE CATHETER:

The Midline is considered a peripheral venous catheter because it does not enter a central vein. The peripheral Midline catheter is described as a catheter which is between 7.5cm – 20cm in length. The distal tip should dwell in the basilic or cephalic veins at or below the axillary level. Medications with pH less that 5 or greater than 9, infusates with an osmolality of greater than 600mOsm/L, vesicant medications or cytotoxic medications are not appropriate therapies for a Peripheral Midline catheter. (Centres for Disease Control, 2002; INS, 2006). Midline catheters have a dwell time of 1-4 weeks and are often referred to as rescue devices.
PATIENT CONSENT

Obtaining Informed Consent

The CDHB Policy provides a framework that describes recommended best practice in all situations that may require informed consent. All staff must ensure they practice within this framework (Volume 11 Clinical Informed Consent). Informed consent is defined as the process whereby someone who has the capacity/competence to consent, having been given sufficient information, arrives at a reasonable decision as to whether or not to agree to a proposed therapy or procedure.

Consent may be given orally or in writing depending upon a number of issues (Refer to page 14 Vol 11). Informed consent is not the act of filling out forms, but rather a process of exchange of information so that an informed decision can be made.

The patient has the right to be accurately and adequately informed about a proposed procedure or treatment and to agree or refuse to have that procedure or treatment. All health professionals have a responsibility to inform patients about a proposed procedure and to gain consent for that procedure. Where difficult situations arise, advice should be sought by the health professional from their clinical director and/or Medical Advisor.

**ACTION:** Ensure patient receives the Patient Information Pamphlet on PICC insertion.

- Read the section on Informed Clinical Consent found in – Vol 11 pages 10-14
Patient Consent Continued:

Use the following anagram ‘BITTEM’ as a quick reference guide to describe or identify risk to patient when obtaining patient consent for a PICC insertion.

**Bleeding** – accidental arterial puncture, venous puncture site may ooze post insertion; instruct patient to keep the arm still for an hour post insertion

**Infection** – Clean arm and use MSB draping to reduce risks of infection during insertion. Always use effective hand hygiene before touching the PICC

**Thrombus** – in vein and PICC lumen can occur. Report any swelling in hands or arm

**Tip malposition** – using fluoroscopy guidance during insertion, and documenting the external measurement of PICC. If excessive vomiting or coughing occurs an X-ray to check position of PICC may be required

**Embolus** – to prevent air or catheter embolus secure catheter connections securely and remove air from the lines

**Mechanical phlebitis** – minimize trauma during insertion. Reduce overuse of arm

**ACTION**: Use this anagram as a prompt when consenting the patient
ANATOMY AND PHYSIOLOGY

Knowledge of anatomy and physiology, the principles of blood flow along with careful assessment of the patient prior to attempting catheter placement is essential for ensuring successful insertion of a PICC or Midline catheter. The PICC inserter needs to know how to identify the carina, heart border and rib spaces and know their significance. Figure 3 and 4 shows the major veins of the central vasculature where PICCs are placed.

All CVADs have the potential to become displaced although displacement is more likely to be seen with PICCs. This is due in part to their smaller diameter. The tip can migrate or become mal positioned in the following veins:

1. Internal jugular
2. Contra lateral brachiocephalic
3. Azygos
4. Migration into the atrium and ventricle

**Action:** Locate the above sites on figures 3 & 4
Choice of Vein for Insertion
Examine both arms using a tourniquet to identify the largest vein on ultrasound. The right basilic vein is the vein of choice however other factors can dictate the vein and arm used for example a patient who has had a mastectomy. For further information on ultrasound refer to the section on Ultrasound in this document.

The Basilic and Brachial veins
The median basilic vein is the vein of choice for PICC insertions owing to its larger size, straighter course for catheter advancement and improved haemodilution capability (INS 2011). The basilic vein begins in the ulnar area (inner aspect) of the forearm, runs along the posterior, medial surface (back of the arm) and then curves towards the anticubital region, where it is joined by the median cubital vein. It then progresses straight up the upper arm for approximately 5–8 cm and enters the deep tissues. It ascends medially to form the axillary vein. Brachial veins are located deep in the arm.
alongside the brachial artery and nerve and are slightly smaller than the basilic. They therefore require ultrasound to locate and access them (Hadaway 2010).

The Median Cubital vein

The median cubital vein ascends from just below the middle of the anticubital region and divides into two vessels one joins the basilic and the other the cephalic vein. The median cubital vein is commonly used for blood sampling owing to its size and ease of access. It is generally not used for PICC insertion because of the site of insertion (constant bending of the arm) which can give rise to complications such as mechanical phlebitis.

The Cephalic vein

The cephalic vein begins in the radial side (thumb side) of the hand and ascends along the outer region of the forearm into the anticubital region, where it forms a junction with the axillary vein. This vein is usually more accessible than the basilic but its size and the sharp angle where it joins with the subclavian vein make it more difficult to advance the catheter. It therefore presents a greater potential for catheter tip malposition (Hadaway 2010).

Valves

Valves are structures within the lumen of the vein which are formed by the endothelial lining of the Tunica Intima. Venous valves appear as bumps and are usually found at vein bifurcation. They are predominantly found in large veins of the extremities, refer to figure 5. There are approximately 40 venous valves between the hand and the distal end of the axillary vein. Larger veins of the central vasculature do not have valves.

Figure: 5&6. Source: Johnson & Johnson Medical
The tunica media is the muscle layer of the vein. Veins have a thinner muscle layer than an artery. Veins are compressible due to less intra luminal pressure, therefore when compressing the vessels under ultrasound the vein flattens where as the artery does not. This allows the clinician to distinguish between the pulsating artery and compressed vein. A thrombosed vein is very hard to compress due to stenosis.

**Trauma to the vein during insertion**

When the Tunica Intima is damaged, bleeding occurs into the interstitial compartments of the basement membrane and the Tunic Adventitia, which is rich in nerves and provides the pain pathway.

One or all three layers can be affected giving rise to phlebitis. PICCs are most affected by mechanical phlebitis. Mechanical phlebitis occurs following a difficult insertion or when the PICC is not secured well causing the PICC to move within the peripheral vein causing irritation to the vein intima. This is often referred to as ‘pistoning’ or moving back and forth.

In addition overuse of the arm where the PICC is in-dwelling can cause the muscles to contract compressing on the vein resulting in irritation to the vein wall giving rise to mechanical phlebitis.

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

1. Chemical
2. Mechanical
3. Bacterial
4. Post infusion related to type of solution

![Figure 7](source: Johnson & Johnson Medical)
Trauma to the lymph system during insertion

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 anticubital fossa and the deep glands of the axilla. Both are responsible for lymph drainage of the arm. 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.
Physiology of blood and blood flow rates

PICCs are inserted into an appropriate vein and advanced along the venous system until the catheter tip reaches its destination in the lower 1/3rd of the superior vena cava. The superior vena cava is on average 20mm in diameter and has a high blood flow of approximately 2000mL/min, far greater than in a peripheral vein (refer to table 1).

This means that irritant drugs and fluids, those solutions with extremes of pH or osmolality can be infused without damaging the SVC vein wall due to increased haemodilution. Therefore when you perform a patient assessment you need knowledge of:

- **Blood viscosity**
  - Results in resistance to flow when pressure is applied.
  - A connection between phlebitis development and elevated haemoglobin levels has been identified.
  - Higher haemoglobin levels produce greater rates of phlebitis due to slower blood flow reducing dilution of irritating medications (INS, 2010)

- **Blood osmolality**
  - Reflects the potential for water movement and water distribution between and within body fluid compartments

- **Blood pH**
  - The body continually produces acids that are then neutralised and excreted to maintain homeostasis.

- **Coagulation**
  - The first stage of clotting process begins immediately after vessel injury when smooth muscle in the vessel wall contracts and reduces the blood flow from the vessel opening.
  - The response of the smooth muscle comes from nerve reflexes and thromboxane released by platelets. A greater degree of trauma produces a greater vasospasm

### VEIN FLOW RATES

<table>
<thead>
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<th>VEIN</th>
<th>DIAMETER</th>
<th>FLOW RATE</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cephalic</td>
<td>6mm</td>
<td>40-60ml/min</td>
<td>38cm</td>
</tr>
<tr>
<td>Basilic</td>
<td>8mm</td>
<td>60-95ml/min</td>
<td>24cm</td>
</tr>
<tr>
<td>Axillary</td>
<td>16mm</td>
<td></td>
<td>13cm</td>
</tr>
<tr>
<td>Subclavian</td>
<td>19mm</td>
<td>150ml/min</td>
<td>2.5cm</td>
</tr>
<tr>
<td>Innominate</td>
<td>19mm</td>
<td>800ml/min</td>
<td>6cm</td>
</tr>
<tr>
<td>Superior Vena Cava</td>
<td>20mm</td>
<td>2000ml/min</td>
<td>7cm</td>
</tr>
</tbody>
</table>
It is important to have knowledge of the flow rates and diameter of veins to determine if the prescribed medication/fluids are suitable if a PICC cannot be advanced through to the SVC and is left in the subclavian vein or becomes a Midline catheter. If medications are irritant, have extremes of pH and osmolality the vein wall can be damaged giving rise to chemical phlebitis which can then lead on to thrombo phlebitis and thrombosis.
INFECTION PREVENTION AND CONTROL

Maximal sterile barrier precautions (MSB) should be used to reduce the chance of catheter contamination and subsequent CRBSI. For the nurse inserting a PICC/Midline catheter and for those assisting in the procedure, maximal sterile barrier precautions means strict compliance with hand hygiene, mask, hat and sterile gown and gloves. For the patient, applying maximal sterile barrier precautions means covering the patient with a large sterile drape, with a small opening for the site of insertion (Centres for Disease Control, 2002; INS, 2006; Institute for Healthcare Improvement, 2008).

Figure: 8.  
Source: Unknown
85% OF BACTERIA FOUND ON THE SKIN ARE RESPONSIBLE FOR CRBSI (Maki, Kluger, Crinch 2006).

Care Bundles

An evidence-based approach underlies the strategies for the prevention of CRBSI. 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. There are two care bundles of components aimed at the prevention of CRBSI (Institute for Healthcare Improvement, 2008). The Health Quality and Safety Commission NZ are currently running a national collaborative in the intensive care units to prevent Central Line Associated Bacteraemia. They are using bundles of care for both insertion and maintenance. They aim to extend this to all inserters of CVADs in the future.

Application of the ‘5 Moments for hand hygiene’ should be incorporated into the insertion process.

**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, sterile gown and sterile 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 patient’s quality of life and possibly their life!

**CVAD insertion bundle**

- Hand hygiene
- Maximal barrier precautions
  - hat,
  - mask,
  - sterile gloves
  - gown for inserter
  - large sterile drape
- Chlorhexidine 2% & 70% alcohol skin antisepsis
- Optimal catheter site selection
- Use of ultrasound guidance

**CVAD maintenance bundle**

- Daily review and documentation of line necessity and prompt removal of unnecessary lines
- Hand hygiene
Dedicated lumen for Parenteral Nutrition (PN). This is the white lumen of a multiple lumen catheter

- Access the CVAD lumens aseptically using vigorous friction and 70% alcohol and 2% chlorhexidine wipes prior to access
- Allow to dry
- Ensure patency is maintained by flushing all lumens
- Use positive displacement devices
- Daily review and documentation of entry & exit site and the surrounding area for signs of infection

PRE INSERTION ASSESSMENT

A thorough and robust assessment process is vital prior to insertion of a PICC/midline catheter. It is important to ensure that contraindications to insertion are identified early and that a comprehensive history is obtained.

Indications for PICC insertion:

- Long term treatment protocols which include irritant and vesicant drugs, medication with extremes of pH and osmolality, cytotoxic and biotherapies and parenteral nutrition.
- Refer to the Notes On Injectable Drugs (NOID) to ascertain medication properties and recommended methods of administration [Notes of injectable drugs hyperlink](#)
- Blood products administration
- Blood sampling
- Poor or limited venous access

Contraindications and Considerations for PICC insertion:

**Persistent Vomiting /coughing**

Situations which cause changes in inter thoracic pressure leading to catheter mal position, catheter erosion or cardiac tamponade. A comprehensive patient history is important to ensure potential complications are avoided.

**Past Irradiation of the Site**

If the skin of the prospective insertion site has been exposed to radiation as part of the patient’s treatment this can compromise the skin integrity making it unsuitable for a PICC insertion.

**Patient Life style / non compliance**

Where the patient’s life style or their non compliance with the device can lead to catheter failure and premature removal

**Skin Infection**
A skin infection at the proposed insertion site. Any bacteria that are on the skin can easily be introduced into the line and cause a septic infection for the patient. It is better to find another site at which to insert a line to avoid skin that already has a bacterial problem.

**Known Central Vascular Occlusions/ Trauma to upper chest or arm**

Anything that may impede the easy feeding of the line into the central venous space is a contraindication for a PICC. For instance, if the vein is thrombosed or if the patient has an indwelling pacemaker, a PICC cannot be inserted on the side in which the pacemaker is resident as it would interfere with the insertion of the line and perhaps the functioning of the pacemaker. Anything else that occludes the vasculature is also a contraindication as is any malformation of the heart that may have required surgery.

**Dialysis Fistula**

A dialysis fistula in the intended arm for the PICC is a contraindication; due to the rerouting of the vasculature of the arm. A possible contraindication is in patients who have end-stage renal disease, as the upper extremity may need to be preserved for future fistula usage; it is important to weigh the risks versus the benefits in such cases.

**Mastectomy and Lymphoedema**

A PICC line cannot be inserted in the arm on the side on which a female has had a radical mastectomy with lymph node dissection, as the lymph system is faulty and unable to drain, so inserting a PICC may lead to further complications.

**Sepsis**

If a patient has a bacterial sepsis, a PICC should not be inserted until the blood cultures come back negative. This is to minimize the risk for further infection and attendant complications. However the PICC insertion should be re-evaluated and discussed with the patient’s team based on the urgency for central line access.

**Patient Assessment for PICC Insertion:**

- Current diagnosis and past history
- Hydration status
- Underlying medical conditions e.g. heart disease, diabetes, atherosclerosis, hypertension
- Previous surgical procedures especially on the side of the PICC insertion
- Previous Central line /PICC /Midline insertion history
- Current medications e.g. warfarin, steroids, diabetic medications
- Physical restrictions or contra indications e.g. CVA, mastectomy
- Ability to self care (if managing the PICC in the home setting)

Consultation with the patient’s medical team is necessary
This algorithm is a tool to assist with the appropriate catheter selection. Consideration must be given to the type of infusates to be administered, specific IV protocols, the length of dwell; underlying conditions such as the immune status and the clinician’s recommended catheter type i.e. double lumen access.

<table>
<thead>
<tr>
<th>CATHETER TYPE</th>
<th>SIZE</th>
<th>MATERIAL</th>
<th>INTERNAL LUMEN SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single lumen</td>
<td>20g /3fr</td>
<td>Polyurethane</td>
<td>0.25 mL</td>
</tr>
<tr>
<td>Single Lumen</td>
<td>18g / 4fr</td>
<td>Polyurethane</td>
<td>0.3mL</td>
</tr>
<tr>
<td>Double lumen</td>
<td>16g / 5fr</td>
<td>Polyurethane</td>
<td>B= 0.3mL, W= 0.25mL</td>
</tr>
<tr>
<td>Power injectable</td>
<td>All the above sizes</td>
<td>Polyurethane</td>
<td>All the above sizes</td>
</tr>
<tr>
<td>Midline</td>
<td>18g /4fr</td>
<td>Polyurethane</td>
<td>0.3mL</td>
</tr>
</tbody>
</table>

Table: 2.
PREPARATION AND INSERTION PROCEDURE

Preparation for PICC Insertion

1. Verify authorized prescriber’s order on requisition
2. Patient consent and education with family/whanau involvement
4. Perform hand hygiene and prepare patient.
5. Remove any excess hair from the skin using clippers
6. Position patient on table in supine position
7. Wash the arm
8. Prepare the room and equipment for insertion
The Insertion Procedure for a PICC

1. Perform hand hygiene using antimicrobial liquid soap or alcohol hand gel
2. Clean the skin of the upper arm to be accessed using a chlorhexidine 2% liquid soap and dry area
3. Don in this order hat, mask, surgical scrub, gown up and double glove
4. Prepare equipment for procedure
5. Prepare the skin with 2% chlorhexidine and 70% alcohol using vigorous friction. Allow to dry
6. Drape the patient using sterile drapes
7. Apply tourniquet
8. Drape ultrasound machine and apply gel to probe
9. Remove outer gloves
10. Access vein using ultrasound and Seldinger technique and insert guide wire when blood appears from needle hub
11. Remove needle over wire
12. Release tourniquet
13. Place peel-a-way introducer into vein by threading over guide wire
14. Remove guide wire and dilator leaving peel-a-way in vein
15. Thread catheter into vein through the peel-a-way 10 to 20cms, then continue to advance slowly using image intensifier guidance until the catheter tip is in position
16. Confirm PICC tip is in lower SVC using radiographic image intensifier
17. Check PICC measurements and document on CVAD Insertion Form
18. Remove peel-a-way, check for blood return and that the catheter flushes well
19. Clean site and secure catheter in position using steri-strips, dress catheter and apply securement device
20. Where a Midline has been inserted ensure an orange ID label has been placed on dressing
21. Dispose of equipment as per best practice and protocols
22. Remove gloves and perform hand hygiene
23. Complete all documentation - Refer to documentation section page 26
24. Give patient all information cards, booklets and documentation
25. Assess patient is stable and there is no bleeding before they leave Interventional Radiology (IR)

For further reading click here: Picc Line Nursing.com
TIPS FOR READING THE CHEST RADIOGRAPHIC IMAGE

Preferred placement of the PICC tip is in the lower third of the superior vena cava (SVC) below the azygos vein and above the heart border

1) If the tip overlies the right main bronchus, the tip is in the SVC below the azygos vein

2) This can be located between the 2nd and 5th intercostals space

3) It is easier to locate the catheter at the clavicle and follow it to the tip than to locate the catheter in the chest region of the film

4) A non portable x-ray will give better quality if fluoroscopy is unavailable

5) If the film is portable and the patient large, have the MRT over penetrate the film. This will make the catheter more visible but these films cannot be used to check lung fields.

Sources: Radiology Department Dunedin Hospital

Figure: 10. Source: Original
CORRECT PICC TIP POSITION

Optimal tip position is still controversial but most consensus guidelines agree the PICC tip should sit in the lower SVC to the SVC/right atrial junction, parallel to the vessel wall. Recent guidelines published in 2013 suggest that in infants and older children the tip should lie in the distal SVC or right atrium. In premature infants earlier papers suggest the tip should lie 5-10 mm outside the cardiac chambers.

This distal position minimises the risk of catheter related complications associated with more proximal positions.

Tip position is influenced by positioning of the arm. Adduction of the arm will cause a line placed via the basilic or axillary vein to migrate towards the heart and a line via the cephalic vein to migrate away. Interventional radiology inserted PICC’s on paediatric patients have images taken with the tip position documented on adduction and abduction of the arm at the time of insertion and these should be available for comparison.

Chest x-rays taken to check PICC position should be performed with the arms at the patient’s side. If the tip position is not adequately identified on a PA or AP chest a shallow right posterior oblique radiograph may be helpful.

Based on the consensus guidelines a satisfactory tip position on a plain radiograph is between the carina and the SVC/RA junction. The SVC/RA junction sits approximately 2 vertebral levels below the carina. (See images)

The SVC/right heart border is not an accurate indicator of the SVC/RA junction but if the carina is obscured the junction sits 10-20 mm below this border in most instances. Other bony landmarks such as the 6th vertebral body or anterior 3rd/4th rib space are less accurate.

If there is ongoing difficulty in determining satisfactory PICC position fluoroscopy with contrast or ultrasound can be performed.

If you have further questions or require PICC advice an interventional radiology resource nurse is available between 8 am and 5 pm on extension 81410. Outside these hours contact the on-call radiology registrar who will liaise with the interventional radiologist as necessary.
Blue oval indicates optimal tip position according to consensus guidelines.
Central venous catheter tips should be positioned in the SVC, therefore allowing the tip to lie parallel to, and not impinge on the vein wall. Contact to the tunica intima disrupts endothelial cells and increases complication rates such as thrombosis (Gamulka, Mendoza & Connolly, 2005; Pettit & Wyckoff, 2007: Racadio et al., 2001). This is best obtained through a right arm insertion site. PICC’s have the potential to migrate into the right atrium with arm movement.

When the arm is adducted catheters inserted in the basilic and axillary veins move towards the heart. On abduction the catheter moves away from the heart, significantly altering the position of the catheter tip. This movement may cause myocardial perforation, and place the patient at risk of pericardial effusion or cardiac tamponade.

Catheter migration is a common problem reported in PICC’s in Paediatric and neonates (Nadroo et al., 2002). No force is placed on any catheter or wire that does not travel smoothly along the vessel. If resistance is felt the guide wire can be replaced with an angled glide wire (Dubois, 1997). Continuous fluoroscopy is used at this stage to ensure the wire advances to the correct position and does not enter the heart as it will cause cardiac arrhythmias.

Bibliography

5. CT angiography of the superior vena cava: normative values and implications for central venous catheter position. JVIR 2008; 19 (3):359-65
7. Silicone venous access devices positioned with their tips high in the superior vena cava are more likely to malfunction. AM J Surg 1999; 178 (1):38-41
**Ultrasound Guidance**

Ultrasound guidance has increased the success rate and minimized complications related to insertions of PICC’s. Ultrasounding the patient’s upper arm allows the inserter to clearly visualize the vein, artery and surrounding anatomy. It also assists to identify problems such as stenosis or thrombosis of the vein (Moureau, 2003, Simcock, 2008).

Ultrasound guidance ensures correct catheter placement, minimising complications such as arterial puncture, mechanical phlebitis, infection and thrombosis and creates reliable access for patients with veins that are difficult to access.

The ultrasound probe (transducer) is placed on the arm so that a transverse view of the vein is obtained (refer figure 11). This view enhances the imaging so that the insertion of the micro puncture needle can be guided into the vein. Once the vein is entered blood will appear at the hub of the needle. Then the micro puncture guidewire can be introduced through the needle into the lumen of the vein. If any resistance occurs, the wire and needle should be withdrawn and the vein re-punctured at another site.

Fluoroscopy is used to observe the passage of the catheter as it is passed along the vein. It visually identifies if the catheter becomes malpositioned and alerts the inserter to take appropriate action.
Contrast Media

Contrast Media is an iodine based contrast used to outline vessels in interventional and diagnostic Radiology. It has mild vesicant properties and can therefore cause tissue necrosis if it extravasates into the tissues. Contradictions to its use are known allergy to contrast and inadequate renal function as per the Christchurch Radiology Services protocols. Contrast media is used to outline the venous anatomy while advancing the catheter if difficulty is experienced. Contrast allows a detailed view of the vein’s pathway and any obstructions or abnormalities so that a decision can be made regarding the accessed vein’s suitability for PICC placement. If there is an adequate pathway through the vein to the SVC a roadmap can be taken and a glide wire used to place the PICC successfully.

Before a PICC nurse inserter can use contrast media during an insertion they must first confirm the administration with a Radiologist, explain the situation to the patient and obtain verbal consent. The use of contrast media in patients with pre-existing renal dysfunction can lead to significant contrast induced nephropathy.

Where the patient’s serum creatinine level is within normal range (<1.5mg/dl) IV contrast media is not contraindicated. Serum creatinine should be monitored before administration, and metformin should be stopped at the time of the administration of CM, and should not be recommenced for 48 hours following (Thomsen, 2006). Where a maximum of 10mL contrast media is administered there is zero risk associated with its use.

If the venous anatomy will not allow for the advancement of the PICC then a decision, in consultation with the Radiologist, will be made to:

1. Change arms
2. Reconsider procedure. The PICC may be pulled back to Midline catheter position
3. Abandon the procedure and discuss alternative venous access with the team.

ACTION:

- Contrast media will only be given when medical assistance is immediately available, in case of adverse reaction.

- IV contrast will be administered using equipment appropriate for particular examination and area of the department it is being given in.

(Ref. Controlled Document CT Procedures & Protocols Contrast Medium 2012, pages 7-9)
PICC’s are inserted in the radiology room with an Image Intensifier, so that fluoroscopy guidance can be used to follow the advancement of the catheter to confirm the final position of the catheter tip.

Organizational policies and procedures must account for radiation protection and authorised personnel who will operate the fluoroscopy equipment.

It is not within the scope of practice for a Registered Nurse at CDHB to operate fluoroscopy or radiographic equipment, therefore a registered Medical Radiation Technologist (MRT) must be present for all imaging of the procedure.

The PICC nurse inserter must have knowledge of hospital and department policies and procedures regarding radiation protection and safety. Therefore it is mandatory to be familiar with the following documents:

- NRL C5 code 1994, Code of Safe Practice for the use or X-Rays in Medical Diagnosis
- Working with X-rays in DSA.
Documentation

Clinical effectiveness is about doing the ‘right thing in the right way and at the right time for the patient (Royal College of Nursing, 2006).

The importance of central line assessment and documentation of findings is often overlooked and can lead to complications which can be avoidable. Effective documentation is an integral part of good patient care (INS, 2010). Documentation provides a pathway to continuity of care. Each point of care reveals the patient’s clinical picture; therefore documentation should be accurate and include the following:

1. Completed requisition for PICC/Midline
2. Accurate documentation of procedure in clinical notes
3. Complete the CVAD Insertion Form and place photocopy in Interventional Radiology (IR) PICC folder
4. IR Register and audit book entry
5. X-ray to be placed on Picture Archiving Communication System (PACS)
6. Complete all electronic entries - Concerto
7. Ensure patient has all appropriate documentation on discharge from Radiology.
INSERTION COMPLICATIONS and MANAGEMENT

PICC insertion complications can occur at any time and be related to many disease processes. Patient-related complications include anatomical abnormalities, heart arrhythmias, behavioral issues such as those encountered when working with the elderly patient with dementia. Mechanical issues such as machine malfunctions, inability to access vein, inability to thread either the guide wire or catheter, malpositioning into the internal jugular vein, atrium or another vein in the upper thorax region may occur.

Dealing with complications during insertion of a PICC/Midline demands knowledge and skill. Therefore a robust PICC nurse insertion programme is essential.

**PICC MALPOSITION**

PICCs can often malposition into the following veins during insertion:

- Jugular vein
- Brachiocephalic vein
- Azygos vein

Causes of PICC malposition:

- This can be due to blood flow, patient diagnosis
- Vascular irregularities or the patient’s position during insertion
- Changes of pressure inside the chest i.e. from vomiting, coughing

Management of PICC Malposition: This involves the following;

- The use of a glide wire effectively repositions the PICC
- The use of a contrast media study of the veins to map their path can be carried out
- Having the patient turn their head towards insertion side can help prevent the catheter entering other veins e.g. jugular
- Asking patient to hold their breath in full inspiration to increase intra thoracic pressure can sometimes facilitate the insertion
- If the PICC is suspected to have travelled into the azygos a lateral projection is required to ascertain this
VEIN PUNCTURE
Guide wires can puncture the vasculature during insertion and when advancing the guide wire.

- Arterial puncture can occur when the artery lies close to the vein. This can be avoided by using ultrasound. When an inadvertent arterial puncture is suspected immediate intervention is necessary. Notify the Radiologist who will initiate a contrast study to confirm which vessel has been punctured. If an artery has been punctured the procedure must be stopped and the access needle and sheath removed. Apply pressure to the insertion sites for 10 minutes and document the incident in the clinical notes.

ACTION: IMMEDIATE INTERVENTION IS NECESSARY FOR THIS COMPLICATION.

CARDIAC TAMponade
Cardiac tamponade, in relation to central venous access devices, is where the intra pericardial segment of the SVC, right atrium or ventricle wall is perforated due to erosion by the CVAD tip. This perforation allows excess fluid to collect between the pericardium and the heart. The fluid causes compression of the heart and prevents the heart from pumping normally (Forauer, 2007).

Signs and Symptoms of cardiac tamponade:
- Unexplained hypotension
- Arrhythmia
- Chest tightness
- Shortness of breath

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
- Position the patient in left lateral trendelenburg
- Administer oxygen
- Call for assistance

Prevention of cardiac tamponade requires that:
- Catheters are made of more flexible material
- The guidewire must be removed completely before trimming the catheter
- The tip of the CVAD to be placed above the pericardium reflection to avoid cardiac perforation
- If fluoroscopy not used heart monitoring can be achieved by ECG
- Accurate assessment of the patient post insertion to ensure appropriate action is taken if tamponade indicated
- Accurate documentation is undertaken.
NERVE INJURY
Nerve injury and irritation can be avoided when the patient is alert to signs and symptoms and is able to report to the PICC inserter during placement of the PICC.

Signs and symptoms of nerve injury:
- Tingling
- Numbness
- Weakness of hand or arm (rare event)

Management of nerve injury:
- If the nerve is stimulated with the needle and pain occurs, needle should be removed and the access site changed
- Explain to patient that the tingling and numbness that occurs will subside
- If any weakness occurs remove needle or catheter immediately

ANATOMICAL ABNORMALITIES
When there are anatomical abnormalities or vein stenosis a PICC can retract on itself or enter a collateral vessel which is sometimes difficult to correct.

Management of anatomical abnormalities:
- The use of ultrasound and fluoroscopy during PICC placement has simplified the process, decreasing the number of x-rays required after the PICC has been inserted.

DIABETES
Inserting a guide wire through the tunica intima of a patient with diabetes is often difficult. This is due to the prolonged and chronic irritation that high blood sugars can have on the endothelial cells that line the tunica intima. This causes chronic inflammation resulting in atherosclerosis (INS, 2010).

Management of PICC insertion and the patient with diabetes:
- Thorough patient assessment prior to the PICC insertion
- Handle the introducer and guide wire gently when accessing the vein
- Discuss any concerns around the blood glucose results with the Medical staff
- Diabetes is a risk factor for infection
SEVERE OEDEMA OF UPPER ARM

Patients that have severe oedema of the arm may present on the ultra sound of the upper arm as 'cloudy picture (INS, 2010).

Causes of severe oedema of the upper arm:

- Disturbances of blood and lymph flow
- Lymphoedema
- Venous insufficiency e.g. cardiac and peripheral vascular disease
- Obstructed blood flow through the arm
- Nephrotic syndrome
- Infection due to viruses, bacteria, protozoa and fungi
- Fluid overload, fluid retention

Management of PICC insertion of an oedematous arm:

- The use of ultrasound provides a reliable means of identifying and guiding the needle to access the vein.
- When patients are referred to IR for a PICC insertion presenting with any of the above causative factors, PICC insertion will be carried out based on the need for urgent venous access to facilitate treatment.

LYMPH VESSEL PUNCTURE

Cause of lymph fluid drainage from the insertion site:

- A lymph structure is penetrated during placement. It will not necessarily be recognised immediately because of the swift action of a small bore-needle into the vein where blood return is the dominant flow.
- A lymph structure has been inadvertently punctured during insertion. It 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.

Symptoms of a punctured lymph structure:

- 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 necessitate 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 a hydrocolloid dressing such as Mepitel film to shield the skin from the fluid.

**Key points:**
- PICC placement in the upper arm seems to have led to an increase in lymph vessel puncture.
- Lymphatic puncture is more common with ultrasound due to increased subcutaneous and muscle tissue between the placement site and vein.
- Lymph vessels lie in a network in the arm to allow transportation and drainage of lymph fluid.
- Amount of fluid discharge from the exit site determines the management of the drainage.

**SCLEROSED VEINS**
When placing a PICC in a patient with sclerosed veins, there may be difficulty in advancing the guide wire.

Management of complications related to sclerosed veins:
- Avoiding any veins diagnosed with suspected sclerosis as seen on ultrasound.
- Handling the guide wire gently.
- Do not force the guide wire in or out of the needle or vein.
- Repositioning the dilator/introducer and re attempting to thread guide wire.
VENOSPASM
Venospasm can occur if the patient is anxious or tense or if the PICC is forcefully inserted or passed quickly along the vein. Venospasm makes it difficult to pass the catheter through the vein and will cause damage to the tunica intima. Bleeding and mechanical phlebitis can result.

Management of venospasm:
- Avoid the problem by pausing and waiting before reattempting insertion
- Insert the PICC slowly
- Place heat packs underneath the arm and axillary region, under the sterile drapes, if venospasm is suspected. This action will aid vasodilatation and relaxation of the tunica media

AIR EMBOLISM
Air embolism is caused by the entry of air into the vascular system creating an intracardiac airlock at the pulmonic valve which prevents the ejection of blood from the right side of the heart.

Causes of air embolism include:
- Catheter fracture
- Inadequate priming of the PICC/Midline prior to insertion
- Deep inspiration during CVAD removal or access device removal (Mirski et al., 2007).

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
CATHETER EMBOLUS

1. Catheter embolism is a rare complication associated with catheters. If the tip of the catheter is sheared off, it may potentially embolise and travel to the lungs. This sequence of events occurs when the guide wire is withdrawn from the catheter and then reinserted or it punctures the wall of the catheter shearing off (Surov, et.al. 2006).

2. ‘Pinch off Syndrome’ is a significant complication involving CVADs and is often unrecognized. It occurs when a CVAD is inserted or passes through the subclavian vein and is compressed by the clavicle and first rib (refer figure 12).

Catheter compression causes intermittent or permanent catheter obstruction and can result in the catheter tearing, transection and catheter embolus. Emboli travel most often to the right side of the heart or pulmonary artery (Masoorli, 2002; Mirza, et al., 2004). Catheter embolism may require fluoroscopic catheterization and retrieval of the catheter emboli.
Summary
Technological advantages in PICC insertion and the application of evidence-based practice for the insertion of PICCs have greatly improved outcomes for the patient. Complications of PICC insertion are greatly reduced when robust education programmes are introduced.

Risk management and quality improvement should be used as a tool to recognize areas for improvement. Records must be kept regarding incidence of insertion complications, interventions and outcomes. Outcomes should be established that are based on evidence-based interventions.

The PICC nurse inserter must be knowledgeable about the risks involved with PICC insertion and must be able to implement measures to prevent their occurrence.

REFERENCES


FOR FURTHER READING:


Harnage, S .RN MAY, 2008


JVAD PICC Tip Location. Summer 1998


Note on Injectable Drugs (NOID). Available in hospital departments [Notes of injectable drugs hyperlink](#).


**ASSOCIATED DOCUMENTS:**

- Adult Central Venous Access Device Insertion Record Form C240189 available through supply department
- Radiology Nurses Sterile set-up Manual available in Radiology department
- Radiology Nurses Protocol Manual available in Radiology department
- Radiology Department Controlled Document CT Procedures & Protocols 2012
- Volume 12 Fluid and Medication Manual 2012 on line document [Vol 12 hyperlink](#)
Paediatric Peripherally Inserted Central Catheter Insertion

An Evidence Based Insertion Package
For Registered Nurses

Radiology Department
Christchurch Hospital
PAEDIATRIC PICC INSERTION

INTRODUCTION
This section on PICC competencies covers the insertion of Paediatric PICC’s. Paediatric PICC insertion is an additional competency and is not expected of all PICC nurse inserters in Radiology. Following completion of the Adult PICC Self learning pack and the subsequent development of these skills the Nurse can progress to become a Paediatric PICC line inserter. Paediatric PICC nurse inserters will be selected based on prior clinical experience, and require further education along with completion of ten successful insertions under supervision in the clinical setting. Paediatric PICC line insertions are achieved in a monitored, controlled environment with an Interventional Radiologist on site (Gamulka, Mendoza & Connolly, 2005).

The insertion of Paediatric PICC’s requires knowledge of the differences between the adult and paediatric anatomy and expert technical skills to ensure a consented, safe, aseptic and correctly placed PICC catheter in a child. In children expert venepuncture is considered to be a significant predictor of a successful PICC line insertion (Pettit & Wyckoff, 2007).

Paediatric PICC’s are considered for children from the age of 0 to 16 years of age. Paediatric PICC insertions have the potential to be more difficult than adults, even though the veins are similar in location; the child’s body and size of their veins are smaller (Frey, 2001).

The insertion procedure involves a number of stages that are different from that of the adult insertion. PICC insertion may be performed under a general anaesthetic or oral sedation. The immobility of the patient contributes greatly to the success of the procedure. Therefore it is important to ensure the correct type of anaesthetic or sedation is chosen.

ACTION:
- For patients receiving oral sedation refer to radiology Nurses Manual policy and procedures for Paediatric Sedation.
- For patients receiving GA refer to CDHB policy and procedures for Paediatric GA.
PERIPHERALLY INSERTED CENTRAL CATHETER (PICC) INSERTION CERTIFICATION FOR PAEDIATRICS

The pre-requisites, for Registered Nurses who wish to be instructed in Paediatric PICC insertion, are:

1. Hold a current PICC Nurse inserter competency IVTC18 P
2. Demonstrate expert skills in the insertion of Adult PICC’s
3. Be recommended and endorsed by the Radiology CNM

Components of PICC Insertion Certification:

4. Peripheral IV Cannulation certification
5. CVAD certification (non Implanted Devices)
6. PICC Nurse inserter competency IVTC 18 P
7. Paediatric PICC Nurse Insertion certification which includes Practical Skills Assessment

Instructions for PICC Insertion Certification:

7. Complete the Paediatric PICC Insertion Package
8. Complete the Theory Test (100% pass is required)
9. Insert ten PICCs under the supervision and instruction of a certified Paediatric PICC Nurse Inserter assessor
10. Perform an additional three Paediatric PICC insertions under observation of the PICC nurse insertion assessor to complete the Practical Skills Assessment component

11. On completion of the Paediatric PICC Nurse Inserters practical assessment all relevant documentation is sent to the Professional Development Unit (PDU) by the Radiology CNM. The nurse’s name is entered onto the CDHB PICC Nurses Inserters Competency training data base and four hours for professional development is given.

12. Re-certification is required every three years. This process will be managed by the Charge Nurse Manager Radiology. Four hours for Professional development will be credited to the RN and entered onto their individual training data base
LEARNING OBJECTIVES

This comprehensive Self directed Learning Package is designed to assist the RN to develop critical thinking skills and demonstrate knowledge in the assessment and insertion of Paediatric PICCs and Peripheral Midline Catheters.

At the completion of the Paediatric PICC Nurse Insertion competency the RN should be able to:

- Describe patient assessment and consent process
- Select the appropriate PICC or Peripheral Midline catheter for insertion
- Describe the anatomy and physiology of blood flow in relation to the insertion of a PICC/Midline catheter
- Describe preferred skin disinfectant in relation to Paediatric PICC/Midline insertion
- Demonstrate knowledge in the use of the ultrasound probe and fluoroscopy
- Demonstrate correct technique for accessing the selected vein and inserting the catheter
- Demonstrate correct techniques in catheter trimming
- Demonstrate knowledge of correct catheter tip position on X-ray and describe abduction and adduction
- Identify complications and describe prevention and intervention of each
- Demonstrate correct dressing and securement
- Describe accurate documentation
- Participate in quality assurance initiatives and audit of PICC insertions

Throughout this package are ‘ALERTS’ and ‘FURTHER READING’

⚠️ This symbol indicates ‘important alerts’

📖 This symbol indicates ‘for further reading’

.setAction This symbol indicates ‘important actions’
Consent

The procedure, its risks, benefits and alternative treatments will be discussed with the child’s parents and an agreement to consent is obtained (Pettit & Wyckoff, 2007). At Christchurch Hospital this is done by the Paediatric Team, before the child is transferred to Radiology. The nurse performing the procedure will meet with the parents and review the insertion procedure, and ensure the consent has been obtained. Assessment of the child is important prior to the procedure as not all children are suitable for PICC insertions (Pettit & Wyckoff, 2007).
Selection

It is important to select the correct catheter for insertion (Donaldson et al. 1995). When short to medium vascular access is required a PICC is an ideal alternative to other surgically inserted ports or catheters in the paediatric population. Gamulka, Mendoza and Connolly (2005) state that midline catheters are not suitable for the paediatric population as it limits the types of therapies that can be administered without complications. It is important to select the correct catheter to insert (Donaldson et al., 1995). When choosing the catheter, additional factors to consider are; age, size of the child, developmental growth, level of activity and sense of body image (Frey 2001).

Catheter Preparation

Before the catheter is inserted a measurement is taken from the antecubital fossa to the lower third of the Superior Vena Cava (SVC). Excess catheter is trimmed following manufacturer’s instructions.

Trimming the catheter to the correct size prior to insertion is important. Always ensure the preloaded wire is removed completely before trimming the catheter. The catheter is cut with the guillotine provided. The wire is then carefully replaced to ensure the wire sits just inside the catheter tip. This is to ensure the inner wire is not severed and fragments dislodged. After trimming flush the catheter with 2-3mls of Sodium Chloride 0.9% to remove air and any internal fragments within the lumen.

Potential risks when trimming the catheter:

1. Trimming the catheter too short
2. Fragments remaining on the trimmed catheter end
3. Depending on catheter and trimming method, creating an irregular catheter tip (Pettit & Wyckoff, 2007).

⚠ Tip should be squarely cut to resemble the original tip.

Always ensure the preloaded wire is removed completely before trimming the catheter.
Skin Preparation

Paediatric PICC’s pose the same risk of infection as adult catheters. The use of chlorhexidine sponges and solutions, combined with MSB draping, disinfection of ports before use and insertions by specialised teams, all reduce the risk of infection in PICC insertions (Levy et al., 2005).

As with adults the child’s arm is cleaned with 2% chlorhexidine and 70% alcohol from axilla to hand then covered using a sterile drape to provide MSB precautions (Pettit & Wyckoff, 2007).

In infants with very low birth weight caution needs to be taken when using alcohol and aqueous solutions. It has been known to cause skin breakdown and erythaema. If povidine iodine is used it must be removed immediately following the procedure to prevent potential absorption, skin damage and risk of hypothyroidism. Consideration should also be given to the type of sterile gloves used as Latex gloves can lead to a latex reaction in infants (Nann, 2003).

⚠️ Neonates require an antimicrobial solution that does not contain alcohol

Anatomical Identification on Ultra Sound

When selecting a vein suitable for catheter insertion, the vein needs to be large enough to accommodate the introducer and the catheter. The axillary vein is large and the benefits are easy cannulation and advancement of the catheter, however it poses the risk of arterial puncture due to its close proximity to the axillary artery (Pettit & Wyckoff, 2007).

The basilic vein is the vein of choice. It is considered that there is less endothelial cell damage due to greater haemodilution between the catheter and vessel wall (Donaldson et al., 1995; Nichols & Doellman, 2007; Pettit & Wyckoff, 2007). The vein is accessed between the elbow and the axilla. Before tightening the tourniquet, the vessels are viewed with the ultra sound probe, to differentiate the vein from the artery. In infants if the tourniquet is applied too tightly arterial blood pressure may be exceeded and the artery can be difficult to identify. Coloured flow Doppler may also be used to distinguish between the two vessels (Donaldson et al.1995).
Insertion

Due to the elasticity of the skin it is necessary to make a small nick in the skin prior to the insertion of the introducer needle. The puncture site needs to be gradually dilated before the catheter is advanced along the vein (Dubois et al., 1997).

Two techniques have been adapted to access the vein. The use of a 23 gauge Angiocath allows the inserter to access smaller veins in younger children, where as the introducer needle in the PICC set is used for the older child.

Ultrasound guidance is recognised as best practice. Venous spasm can occur therefore careful advancement of the guide wire ensures the potential puncturing of the vein is minimised and/or recognised early. It is important to not force the guide wire or catheter through the vein if spasm occurs. Damage to the tunica intima disrupts endothelial cells and increases complication rates such as thrombosis (Racadio et al., 2001). If an arterial puncture is suspected stop the procedure immediately and review the situation.

Paediatric PICC placement under fluoroscopy guidance in Interventional Radiology offers several advantages such as immediate tip manipulation to the correct central position. It is important to commence fluoroscopy guidance after advancing the catheter 5 to10cms in all paediatric patients. Preventing delays in treatment and ensuring a high insertion success rate (Fricke et al., 2005; Pettit & Wyckoff, 2007). Catheter migration is a common problem reported in PICC’s in Paediatric and neonates (Nadroo et al., 2002).

Correct Placement of PICC

Central venous catheter tips should be positioned in the SVC, therefore allowing the tip to lie parallel to, and not impinge on the vein wall. Contact to the tunica intima disrupts endothelial cells and increases complication rates such as thrombosis (Gamulka, Mendoza & Connolly, 2005; Pettit & Wyckoff, 2007; Racadio et al., 2001). This is best obtained through a right arm insertion site. PICC’s have the potential to migrate into the right atrium with arm movement.

When the arm is adducted catheters inserted in the basilic and axillary veins move towards the heart. On abduction the catheter moves away from the heart, significantly altering the position of the catheter tip. This movement may cause myocardial perforation, and place the patient at risk of pericardial effusion or cardiac tamponade.

Catheter migration is a common problem reported in PICC’s in Paediatric and neonates (Nadroo et al., 2002). No force is placed on any catheter or wire that does not travel smoothly along the
vessel. If resistance is felt the guide wire can be replaced with an angled glide wire (Dubois, 1997). Continuous fluoroscopy is used at this stage to ensure the wire advances to the correct position and does not enter the heart as it will cause cardiac arrhythmias.

**CORRECT PLACEMENT IN SVC**

*Normal position in SVC*  
*Position on adduction*  
*Normal position in SVC*  
*Position on abduction*

**Imaging**

Following insertion radiographic images of abduction and adduction of the catheter in its final position are taken and documented. This ensures that the PICC’s tip is at the optimum position following insert.

Other images related to the procedure will be taken also e.g. images requiring contrast media.
Contrast Administration
Contrast media may be required to document cases of vasospasm or vein narrowing due to previous catheter insertions. The policy and procedures to ensuring dose does not exceed more than 2mls/kilo must be followed.

Radiation Dose
The risk of radiation exposure is higher in children than adults. This is due to higher water content and increased cell division. The principles of ALARA (as low as reasonably achievable) should apply when imaging of paediatric patients occur. Selection of the appropriate procedure, using the shortest possible imaging times, ensures that no additional images are required and by having the child lying still all contribute to reducing radiation dose.

Dressing Application
As per paediatric dressing policy (Paediatric PICC/Midline form C270049) a paediatric Bipatch® is placed over the insertion site and the catheter secured with steri-strips and bio-occlusive dressing. It is important to ensure that the entire dressing and bandage are not too tight as to impede blood supply in the arm.

The catheter is marked at 2cm from the insertion site with an indelible pen so as to provide a way to monitor the external length of the catheter and thus detect any catheter migration.
PICC insertion, maintenance and care is documented on the Paediatric PICC Line Insertion Form C270049.
REFERENCES:


ASSOCIATED DOCUMENTS

CDHB Policy and Procedure Manual Paediatric undergoing GA

CDHB Child Heath video on PICC insertion Internet

Volume 12 Fluid and Medication Manual 2012 on line document Vol 12 hyperlink