Ultrasound PICC Insertion Workshop

Joy Blacka (RN, MCP, VA-BC)
Disclosures

• Joy Blacka is a full time employee of Teleflex Medical ANZ
Networking, Research & Learning

- **NZINS**: [http://www.ivnnz.co.nz/](http://www.ivnnz.co.nz/)  
  [http://www.ivnnz.co.nz/about-ivnnz-inc./Infusion-Standards-of-Practice](http://www.ivnnz.co.nz/about-ivnnz-inc./Infusion-Standards-of-Practice)
- **CNSA**: [https://www.cnsa.org.au/](https://www.cnsa.org.au/)
- **INS**: [www.ins1.org](http://www.ins1.org)
- **AVA**: [http://www.avainfo.org/](http://www.avainfo.org/)
PICC & Midline On Line Resources

Quick Start Guide to Education
Access has been provided to you by Teleflex

You now have access to PICC Fundamentals, free online education (with CE's) sponsored by Teleflex Vascular Access Division. All education is available through a link with PICC Excellence, Inc., 24 hours a day/7 days a week from any internet access terminal.

Simply follow these instructions:
1. Go to www.piccexcellence.com
2. At the top of the home page, click Log In or Log Out/Create New account
3. Find Create Personal or Site License Account on the drop down menu and click on it.
4. Select Company/Organization Teleflex
5. Click Continue
6. Choose Company Subsidiary (using drop down menu) Your Hospital Name
7. Enter Company Portal ID PICC Fundamentals
8. Enter Company Portal Password VAD101
9. Click SUBMIT

To save your work always click SAVE & EXIT when you walk away from the online class and the program will save your place.

FIRST TIME USERS:
Complete info under: Create Your Site License Account
- Remember your email
- Remember your password
Health Outcomes

The effect of treatment & care, by health professionals, on patients
Vascular Access Outcomes

- Successfully complete infusion therapy
- Reduced VAD related complications
- Reduced number of venepunctures per patient
- Patient Satisfaction
- Reduce exposure to blood borne pathogens
- Reduce supply & labor related costs
CDC Guidelines 2011

• Select device based on intended purpose, duration of use, known infectious and non-infectious complications and experience of individual catheter operators. (Category 1B)

• Use a midline catheter or a PICC, instead of a short peripheral catheter, when the duration of IV therapy is likely to exceed six days. (Category 11)

• Educate health-care workers regarding indication for ivcs, proper procedures for the insertion & maintenance of ivcs (Category 1A)

• Assess knowledge of & adherence to guidelines periodically for all persons who insert & manage intravascular catheters (Category 1A)

• Designate only trained personnel who demonstrate competence for the insertion and maintenance of peripheral & central intravascular catheters (Category 1A)

• Use a sutureless securement device to reduce the risk of infection for intravascular catheters (Category 11)

• Use ultrasound guidance to place CVCS to reduce number of cannulation attempts and mechanical complications (Category 1B)
Tip Position

1. PICC

2. Midlines / Peripheral Cannulas
Device Selection

Decision Tree

Patient Requires IV Therapy

- Osmolarity of solution less than 900mOsm/L
  - Not listed as irritant or vesicant
    - Peripheral Access (Good)
    - Three sites or more

- Duration less than 5 days
  - Maintain by peripheral cannula

- Duration greater than 7 days
  - 2-4 weeks midline
  - Greater than 4 weeks PICC

- Osmolarity greater than 900mOsm/L, irritant or vesicant
  - Needs maximum hemodilution
  - Central access - intravenous
    - nutrition, chemotherapy, irritants, vesicants
    - hyperosmolar solutions

- Consider a duration less than one year
  - PICC or Tunneled CVC or Totally implanted infusion devices

- Duration greater than 1 year
  - CVC-or totally implanted infusion devices
What is a Midline

A midline catheter is a peripheral venous catheter:

• 8-20 cm long
• Inserted preferably in the upper arm, secondarily the region of the antecubital fossa (INS 27, Pg. S54)
• Terminates at or below the level of the axilla and distal to the shoulder (INS 33, Pg. S65)
• Can be inserted in the basilic (preferred), median cubital, brachial, or cephalic vein (INS 27, Pg. S54)

Choosing a Midline Catheter

- Use cautiously with intermittent vesicant administration (INS 26, Pg. S51)
- Risks include: Undetected extravasation, undetected phlebitis, thrombophlebitis leading to venous thrombosis, infiltration and extravasation
- Vancomycin administered via midline for 6 days was found to be safe in one study (2)

- Avoid use with:
  - History of venous thrombosis
  - Hypercoagulability
  - Decreased venous flow to extremities
  - End-stage renal disease requiring vein preservation (INS 26, Pg. S51)

---

**Medication Assessment for Midline Catheter**

Osmolarity:
- The number of osmotically active particles in a solution (INS Pg.S153)

Vesicant:
- An agent capable of causing tissue damage when it escapes from the intended vascular pathway into surrounding tissue (INS Pg.S155)

Irritant:
- An agent capable of producing discomfort (e.g., burning, stinging) or pain as a result of irritation in the internal lumen of the vein with or without immediate external signs of vein inflammation (INS Pg.S151)

Including medication assessment ensures the clinician is following the principles of Vessel Health and Preservation
PICC & Midline Advantages

- Eliminate multiple venepunctures
- Offer increased haemodilution
- Cost-effective and time efficient
- Decreased risk of infiltration/extravasation
- May be inserted at the bedside
- Increased patient satisfaction
- Decrease or eliminate risks associated with insertion into the chest or neck
Disadvantages of PICC and Midline Catheters

• Require adequate peripheral veins
• Smaller gauge size when comparing PICCs to other CVCs
• Require special training and credentialing for clinicians
• Require practice and continuing education to maintain competency
• Midlines are appropriate for peripheral solutions only
Considerations When Placing a PICC or Midline

Assess the extremities for contraindications
Phlebitis
Infiltration or extravasation
Hematoma
Previous venepuncture sites
Dependent oedema
Localized infection near the proposed insertion site
Prior injuries, surgeries, vascular access device complications that have altered venous anatomy or venous return
Presence of dialysis grafts or fistulas
Impaired neurologic function
Types of PICCs / Midlines

- Silicone / Polyurethane
- Open Ended / Closed Ended
- Proximal valve/ Distal valve
- Gauge / Sizes
- Single Lumen / Multi lumen
- French/ Tapper French
- Pressure injectable/ NON pressure injectable

The Arrow® PICC Advantage

- **Staggered Exit Ports**
  - Innovative design reduces the risk of mixing incompatible medications that can create precipitate.

- **Blue Flextip**
  - Soft, contoured design enhances maneuverability while minimising the risk of vessel trauma.

- **Taperfree Catheter Design**
  - Minimises risk of catheter-related thrombosis and ensures stated French size is consistent between distal and proximal ends.

- **Glidethru Peelable Sheath Over Dilator**
  - Smooth dilator to sheath transition reduces need for skin nick.

- **Increased Radiopacity of the Catheter Body**
Vein Assessment and Site Selection

Basilic Vein
Median Basilic
Cephalic
Median Cephalic
Accessory Cephalic

Veins of the Upper Extremity and Thorax
Placing a PICC can improve patients health outcomes

Reduces adverse events related to peripheral cannulas

The Right Line ➔ The Right Patient ➔ The Right Time ➔ The Right Securement
Successful PICC Insertion

Right Vein
Right Insertion Site
Right Tip Position
Good Assessment

The Right Line  ➤  The Right Patient  ➤  The Right Time  ➤  The Right Securement
Trends with PICCs

- Expanding Scope of Practice
- PICCs inserted with MI & Ultrasound at the bedside / procedure room
- ↑ CT, ↑ need for Power Injection via PICCs
- Saline Only Maintenance
- Need to monitor CVP via PICCs
- Ability to do a wire exchange
- Tip positioning technology
What is Ultrasound?

- Vibrations of the same physical nature as sound but with frequencies above the range of the human ear
- Noninvasive technique involving the formation of a two-dimensional image

It compares to an ECHO . . .

Reflection of sound arriving at the source some time after the sound was generated
Ultrasound Image

**Dark** – less reflection of sound waves with low density structures creating weakest resolution

**Light** – more reflection of sound waves with high density structures creating strongest resolution
Advantages

• Promotes safety
• Allows for real time visualization
• Portable
• Increased insertion success rate
• Less vessel trauma than with blind insertion
• Ability to access deeper veins that are non-palpable
• Increased patient comfort and satisfaction
Additional Considerations

- Additional supplies required
- Equipment availability
- Extra training for use of ultrasound
- Learning curve dependent on user skills
**Assessment**

**Vessel assessment prior to insertion**
- Assures vein is patent
- Determines appropriate size/depth of vessel
- Characteristics of pathway and blood flow in vessel
- Determines the location of surrounding anatomical structures

**Assessment of vessel after insertion**
- Determines continued patency of vein
- Recognition of catheter related vessel thrombosis
- Troubleshooting
Ultrasound Equipment

Machine
- Body
- Controls
- Screen
- Transducer(s)

- Gel
- Probe cover
- Needle guides
**Ultrasound Transducer**

Responsible for:

- Emitting sound waves
- Receiving sound waves
- Sound waves bounce off solid structures in the body and reflect back to transducer
- Pass through liquid structures
Transducer

• Center of transducer is important for alignment of needle; the arrow faces clinician

• Side marking for orientation of probe to the screen of machine
Using gel to optimize image

• Gel is the conductor required for transmission of sound waves
• Air interferes with conduction and distorts picture
• Sterile gel use during procedure
Gain

Used to adjust enhancement of the screen image

- Near field is most superficial or closest to the transducer
- Far field is deeper or farthest away from the transducer
- Optimal gain is a balance of near and far gain that is used to increase or decrease the overall brightness of an image

Gain is too bright  
Gain is too dark  
Optimal gain
**Depth**

- Allows various depths of visualization within area
- Increasing depth narrows the screen, making the vessel appear smaller
- Depth markers identify vessel location in relation to surface of skin
Vessel Measurements

- Selecting the calipers
- Calipers measure the diameter of the vessel
- Choose a vessel that allows catheter to vessel ratio of 45% or less¹
- Assess the vessels in a natural state, without a tourniquet
Ultrasound views

Transverse View (Axial)

Longitudinal View (Sagittal)
Transverse view out of plane

- Transverse = Position the probe perpendicular to the vessel

- Out of plane = Position needle perpendicular to the probe
**Longitudinal view in plane**

- Longitudinal = positioned probe vertically and parallel to the vessel

- In plane = Position of the needle parallel to the probe
Identifying differences of veins and arteries

Both circular black structures

Veins are:
• Easily compressible
• Should not be pulsatile
• Thinner walls

Arteries:
• Pulsate
• Difficult to compress
• Arterial walls appear thicker
Anatomy of upper arm

Significant upper extremity structures

- Veins
  - Basilic
  - Brachial
  - Cephalic

- Artery
  - Brachial

- Nerve
  - Median cutaneous
Basilic vein

• First vein of choice for PICC placement\(^1\)
• Vein located in the inner aspect of upper arm
• Lies away from arterial and nerve structures
• Progressively gets larger towards central circulation
• Joins brachial vein(s) in upper arm, creating the axillary vein
**Brachial vein**

- Deeper vessel
- Size varies
- Close proximity to median nerve and brachial artery
**Brachial artery**

- Pulsatile when firmly compressed
- Formed when the radial and ulnar artery join at the antecubital area
- Lies between the biceps tendon and the median nerve
- Surrounded by the brachial vein(s)
- Above brachial artery is median nerve bundle
Nerves

- Lies near the brachial artery
- Appears as “cauliflower” bundle near the brachial artery
- Identify nerves prior to cannulation
- Assess for post insertion pain
Summary

- Pre insertion assessment of:
  - Vessel anatomy
  - Vessel patency
  - Surrounding anatomical structures
- Ultrasound is the key for safe device insertion
- Education and training is essential
- Access to proper equipment and supplies is necessary
References

3. AHRQ. Chapter 21 2016 02-25
SOP 47. Central Vascular Access Device Tip Location

Practice Criteria

• Tip should be in lower segment of SVC at or near CAJ
• Deeper tip location (near tricuspid valve or ventricle) is associated with cardiac arrhythmias (II)

• Use ECG technology in real time for tip location (II)
• ECG technology is more accurate, allows more rapid initiation of infusion therapy and reduces cost (II)
• Tip confirmation by chest radiograph when ECG unavailable

• Document CVAD tip location in medical record
• Place ECG tracing, radiology report or other appropriate report in the medical record

Infusion Therapy Standards of Practice 2016 www.ins1.org/
Tip Positioning Technology

Tip Positioning

• ECG Interpretation P Wave (Arrow VPS Rhythm)

Navigation + Tip Positioning

• Magnetic Tracking (Sherlock 3CG & Arrow VPSR)
• *Doppler (Arrow VPSG4)
• ECG Interpretation “R” Wave (Arrow VPSR)

*Not registered or available in ANZ
ECG Interpretation for Tip Position of CVCs

Figure 1
No evident P-wave hangs indicates catheter is not in acceptable position.

Figure 2
A P-wave at its maximum height will indicate the catheter is in the lower 1/3 of superior vena cava/right atrial junction.

Figure 3
A downward deflection on the leading edge of the P-wave indicates the catheter entering the right atrium.

Figure 4
A biphasic P-wave indicates the catheter is within the right atrium.

Figure 5
An inverted P-wave indicates a catheter is approaching the right ventricle.
Arrow VPS Rhythm

Navigate
TipTracker™ Navigation

Confirm
Using Familiar ECG Technology

Eliminate
No chest X-ray

Find Your Rhythm
P Wave Verification of Tip Position
Navigation
## Eliminate Chest X-Ray

<table>
<thead>
<tr>
<th>Group</th>
<th>Guideline</th>
<th>Method of Confirmation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW Health Policy (2011) (Review September 2016)</td>
<td>It is reasonable to expect that a CVC tip should be: 1. in the superior vena cava 2. above the cephalic limit of the pericardial reflection 3. at a level corresponding to the carina on a chest radiograph</td>
<td>Chest X-Ray</td>
</tr>
<tr>
<td>INS (2016) (Infusion Nurses Society)</td>
<td>Lower segment of SVC at or near CAJ</td>
<td>1. ECG 2. Chest X-ray</td>
</tr>
<tr>
<td>WoCoVa Consensus Statement (2013)</td>
<td>At or near the CAJ</td>
<td>• Fluoroscopy  • ECG  • Chest X-Ray</td>
</tr>
</tbody>
</table>
How you measure . . .
To the SVC/ CAJ........

Three ways to Measure

Palpate intercostal spaces
Sternal angle (angle of Louis)
Suprasternal notch and xiphoid process


The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
PICC Tip Positioning

Types of PICC Insertion

Modified Seldinger

Seldinger
MODIFIED SELDINGER TECHNIQUE

Uses a 21 gauge needle to access vein followed by introduction of a soft-tipped guidewire. Needle is removed and peel-away sheath/dilator assembly inserted over guidewire. Guidewire and dilator are removed; catheter is threaded through introducer to final tip location.
3. Dilator + Peel Apart Introducer

1. Small Needle or Cannula

2. Guidewire
Advantages of MST Insertion

Less Trauma during insertion
Preferred method with US
Enables insertion site above antecubital fossa
Higher Success Rate
Happier Patients
Tips for Working with Guidewires

Respect the angle of the wire. The guidewire sits at a particular angle.

Maintain a slight back traction on the wire. This helps the dilator and/or catheter slide over the wire properly.

Monitor for kinks. If the wire is not advancing smoothly or a dilator is not inserting properly, a kink is the likely cause.

Advance the guidewire slowly in short strokes, 1-2 centimetre increments.

Do not wrap the wire over fingers or wrist.
Placement Wire (Stylet) and Guidewire Considerations

**Stylet**
Thin flexible wires placed within catheters to facilitate introduction

**Guidewire**
Thin flexible wires inserted into the vein to allow for sheath/dilator insertion
Soft flexible tip

Never cut a stylet /placement wire or guidewire
Review Procedure

Which vein / s
Name the 2 insertion techniques
Measurement
Full Barrier Precautions
Skin Prep
The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
Post Procedure

X-ray
Tip location technology required documentation
Securement
Documentation
Hand over
Practice Recommendations to determine Tip Position

Chest X-Ray

Ongoing position check:
Aspirate & Flush Line pre & post drug administration
Compare how much catheter is outside the patient compared to insertion notes
Ensure good securement

The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
Consequences......

To Far in.........

↑ Cardiac Arrhythmias

↑ Cardiac Tamponade

The Right Line  ➤ The Right Patient  ➤ The Right Time  ➤ The Right Securement
Phlebitis

Mechanical
Use the smallest gauge PICC
Use the Basilic Vein
Have the tip in the SVC
Insert the PICC with minimal movement @ insertion site
Ensure good securement of PICC

Chemical
Catheter to vein ratio
Adequate hemodilution
Appropriate pH and Osmolality for device

The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
### Vessel Diameter and Flow

<table>
<thead>
<tr>
<th></th>
<th>Radius of Vessel (mm$^4$)</th>
<th>Length (CM)</th>
<th>Actual Diameter</th>
<th>Approx. mL/Min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cephalic</td>
<td>3$^4$</td>
<td>38 cm</td>
<td>2-4 mm</td>
<td>81</td>
</tr>
<tr>
<td>Basilic</td>
<td>4$^4$</td>
<td>24 cm</td>
<td>4-6 mm</td>
<td>256</td>
</tr>
<tr>
<td>Axillary</td>
<td>8$^4$</td>
<td>13 cm</td>
<td>16 mm</td>
<td>4,096</td>
</tr>
<tr>
<td>Subclavian</td>
<td>9.5$^4$</td>
<td>6 cm</td>
<td>19 mm</td>
<td>8,145</td>
</tr>
<tr>
<td>SVC</td>
<td>12.5$^4$</td>
<td>7 cm</td>
<td>20 mm</td>
<td>24,414</td>
</tr>
</tbody>
</table>

---

The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
Types of Occlusions

Reasons for Occlusion:
Mechanical:
Kink in the catheter
Positional – the catheter rests up against the vessel wall preventing flow
Catheter malposition secondary to poor dressing technique
Ruptured catheter or Migration

Non-Thrombotic:
Intraluminal obstructions caused by: medication precipitates such as lipids, incompatible infusates/medications
Poor flushing volumes in between incompatible medication administration

Thrombotic:
Intraluminal thrombus
Extraluminal fibrin sleeve formation
Mural thrombus (DVT)
Complete occlusion of the vessel

The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
Assessment & Detection of CVAD Occlusions

Flushing (Resistance)
Aspiration (Blood withdrawal / Patient position)
The patient
Check the external catheter
Infusion Regimes
X-Ray

The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
Flushing


The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
Flush Techniques

**Pulsatile** flushing to create turbulence and clean the inside of the catheter

**Positive Pressure**

- “Clamp technique” or positive pressure displacement devices

If using positive displacement devices **DO NOT** clamp until syringe is removed from injection bung

The Right Line ➔ The Right Patient ➔ The Right Time ➔ The Right Securement
Tips for Securement

Attach securement no more than 2 -3cms from insertion point
Clean skin area with preferred antiseptic, allow to fully dry prior to application of securement. (Clip if hairy)
Minimise movement to reduce risk of migration
Dressing

The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
Infection Prevention

Full Barrier Precautions with Insertion
Use Aseptic Technique for all Manipulations
Disinfect skin using a >0.5% Chlorhexidine & Alcohol based solution
Know your Products
Wash thy hands

The Right Line ➤ The Right Patient ➤ The Right Time ➤ The Right Securement
Catheter Removal

Removal by “qualified” individuals
Removal procedure
Patient supine, HOB elevated
Maintain insertion site below level of heart
Remove dressing
Remove the catheter gently and slowly in 2-4 cm increments
Have patient hold breath as catheter exits insertion site
Cover the insertion site with a sterile, occlusive dressing
Measure and record the length of the catheter
Document the procedure
Thank You