Disclosures

The speaker’s presentation today is on behalf of Bard Access Systems. Any discussion regarding Bard products during the presentation today is limited to information that is consistent with Bard labeling. Please consult Bard product labels and inserts for any indications, contraindications, hazards, warnings, cautions and instructions for use. Results presented may not be predictive for all institutions or patients.
Objectives

• Asserting your role as vascular access champion
• Emphasize the importance of appropriate device selection
• Central Venous Access in the ICU
Why is Appropriate Selection So Important?

• Scrutiny on Hospital Acquired Conditions (HACs)
• More device choices
• Potential inappropriate use
• Consequences to patient
Not long ago, most of us had a limited selection of devices … … but that is changing quickly
New device options create the potential to choose a device that:

- Is more readily available
- Has less risk of serious complications
- More closely matches patient needs
- Is less costly to place
New device options also create the potential to choose a device that may:

- Be inappropriate for required infusates
- Be unable to fulfill all required functions
- Be unable to last the duration of therapy
- Have risk of serious complications
- Be more costly over course of therapy

Critical Assessment is More Important Than Ever

Key Drivers of Critical Assessment

- Type of therapy
- Duration of Treatment
- Difficulty of insertion
- Patient factors
- Other Factors

Type of Therapy: Vesicants and Irritants

- Total parenteral nutrition
- Many chemotherapeutics
- Many antibiotics
- Vasopressors
- Hypertonic saline
- Calcium Chloride/Calcium Glutonate

Will your patient need these during the course of therapy?

Chemotherapy and Biotherapy Guidelines and Recommendations for Practice ONS (2009) pg 105
Changing views on pH … situational questions are important

- Continuous vs intermittent?
- Length of therapy?
- Patient tolerance?
- Multiple infusates?

Patient Considerations

• Medical condition(s) existing simultaneously but independently with another condition

• Perform a history for:
  1. Potential previous I.V. Therapy
  2. Potential previous hospitalization
  3. Potential previous venous complications – including thrombosis

Additional Factors

- # of lumens required
- Required flow rates
- Need for blood draws
- Central venous pressure (CVP) monitoring
- Power injection
Central Venous Access Devices in the ICU

- Integral part of modern Intensive care
- Required for CVP monitoring (CVPM)
- May be needed for complex fluid / nutrition management
- Recommended for stable delivery of vasoactive medications
Ideal CVADs?

- Easy to Insert or Inserted by Others
- Meets Complete Venous Access Needs
- Avoids Complications
- Removed When Not Needed
- No Negative Financial Impact
CVAD Decisions in the ICU
A simple process?

Patient Admission into ICU and needs a CVAD

- Emergent Status? (High Flow and Quick Access Needed)
  - YES: Insert CICC
  - NO: IJ, Subclavian or Femoral Access Available?
    - NO: Insert PICC
    - YES: Right or Left Arm Indicated for Use?
      - NO: Insert CICC
      - YES: Insert CICC
Catheter Flow Rate
### Example of CICC Flow Rates

<table>
<thead>
<tr>
<th>LUMEN</th>
<th>Ø FR.</th>
<th>LENGTH</th>
<th>INTERIOR LUMEN</th>
<th>DESIGN</th>
<th>MATERIAL</th>
<th>FILLING VOLUME</th>
<th>FLOW RATE (^*)</th>
<th>MAX. PRESSURE INJECTION FLOW RATE (^**)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>7 Fr.</td>
<td>16 cm</td>
<td>18-14</td>
<td>D</td>
<td>PUR AGB</td>
<td>0.33/0.50</td>
<td>1300/5600</td>
<td>5/10</td>
</tr>
<tr>
<td>2</td>
<td>7 Fr.</td>
<td>20 cm</td>
<td>14-18</td>
<td>B</td>
<td>PUR AGB Plus</td>
<td>0.57/0.40</td>
<td>5700/1100</td>
<td>10/10</td>
</tr>
<tr>
<td>2</td>
<td>8 Fr.</td>
<td>16 cm</td>
<td>14-14</td>
<td>E</td>
<td>PUR AGB Plus</td>
<td>0.68/0.70</td>
<td>7650/6000</td>
<td>10/10</td>
</tr>
<tr>
<td>2</td>
<td>8 Fr.</td>
<td>20 cm</td>
<td>14-14</td>
<td>E</td>
<td>PUR AGB Plus</td>
<td>0.73/0.75</td>
<td>6450/4800</td>
<td>10/10</td>
</tr>
<tr>
<td>3</td>
<td>7 Fr.</td>
<td>16 cm</td>
<td>16-18-18</td>
<td>H</td>
<td>PUR AGB Plus</td>
<td>0.38/0.37/0.39</td>
<td>3000/1400/1600</td>
<td>10/5/5</td>
</tr>
</tbody>
</table>

\(^*\) Teleflex™, Arrow™ Pressure Injectable CVC Brochure 1-2013
**Example of PICC Flow Rates**

<table>
<thead>
<tr>
<th>Lumens</th>
<th>Priming Volume (ml)</th>
<th>Max. Achievable Pump Flow Rate(^*) (ml/hr)</th>
<th>Gravity Flow Rate (ml/hr)</th>
<th>Power Injection Flow Rate (ml/sec)@300 psig</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 Ga (Red)</td>
<td>0.68</td>
<td>Saline (1.0 cP) &gt;999 TPN (2.0 cP) &gt;999 Blood (3.5 cP) 611</td>
<td>743</td>
<td>5</td>
</tr>
<tr>
<td>19 Ga (Gray, White)</td>
<td>0.44</td>
<td>Saline (1.0 cP) &gt;999 TPN (2.0 cP) 566 Blood (3.5 cP) 323</td>
<td>280</td>
<td>N/A</td>
</tr>
</tbody>
</table>

\(^*\)Based on a simulated testing using a pump alarm setting of 500 mmHg and a full length catheter at 55 cm. May not be indicative of actual clinical performance.

**Indications:** The PowerPICC™ catheter is indicated for short or long term peripheral access to the central venous system for intravenous therapy, power injection of contrast media, and allows for central venous pressure monitoring. For blood sampling, infusion, or therapy use a 4 French or larger catheter. The maximum recommended infusion rate is 5 mL/sec for power injection of contrast media. For central venous pressure monitoring, it is recommended that a catheter lumen of 20 gauge or larger be used.

Please consult product labels and inserts for any indications, contraindications, hazards, warnings, precautions, and directions for use.

CVP Comparison of PICCs vs CICC/PACs


...and PICCs have come a long way

Early Years
- AC insertion without US
- Over the needle insertion
- No CHG
- Suture/tape securement
- X-ray confirmation

21st Century Renaissance
- Upper arm USG insertion
- MST insertion
- CHG & maximum barrier
- Mechanical securement
- X-ray tip confirmation
- Power injection
- Reverse Taper

Modern Practice
- Vein-to-catheter ratio
- Hub cleaning & protection
- Tip guidance & ECG based tip positioning
COMPLICATION MANAGEMENT
Placement Risk Considerations
Risks of Placing and Removing PICCs & CICCs

<table>
<thead>
<tr>
<th>HAC[^8]/non-HAC</th>
<th>PICC</th>
<th>CICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLABSI[^8]</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Air Embolism[^8]</td>
<td>Not Listed</td>
<td>X</td>
</tr>
<tr>
<td>Pneumothorax[^8]</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Hemothorax</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Brachial Arterial Injury</td>
<td>X</td>
<td>--</td>
</tr>
<tr>
<td>Carotid/Subclavian/Femoral[^23] Arterial Injury</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Hematoma</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: Arterial injury expanded to include femoral artery based on Bowdle (2014) observations.\[^23\]

\[^8\]Hospital-Acquired Conditions and Present on Admission Indicator Reporting Provision. Centers for Medicare & Medicaid Services. ICN 901046 September 2014
Patient Position & Condition Considerations

Example 1
Insertion Position
CICC: Trendelenberg (required)\textsuperscript{10}
PICC: No requirement

Example 2
Neurology or Pulmonary Issues
CICC: Reverse Trendelenberg (required)\textsuperscript{10}
PICC: No requirement

Other Considerations
PICC may be suboptimal if:
- ESKD (III or IV)\textsuperscript{24}
- Past breast surgery\textsuperscript{25}
- History of VTE\textsuperscript{24}
- Arm burn, infection, paralysis\textsuperscript{24}

CICC may be suboptimal if:
- Neck/chest abnormalities\textsuperscript{24}
- High infection risk/tracheotomy\textsuperscript{24}
- Longer dwell time foreseen\textsuperscript{25}

\textsuperscript{25}Helen Hamilton and Andrew R. Bodenham. Central Venous Catheters. (United Kingdom. John Wiley & Sons Ltd. 2009) 38-84
Required Life Supporting Devices: Competing for Real Estate

Insertion Site Choice

CICC
- neck
- clavicular triangle
- groin

PICC
- either upper arm
Insertion Site Choices

CICC
- neck: proximity to ear, nose & throat
- clavicular triangle: upper chest
- groin

PICC
- either upper arm

11 Avoid using the femoral vein for central venous access in adult patients.
CLABSI Risk of CVADs in the ICU

• Do not use peripherally inserted CVCs (PICCs) as a strategy to reduce the risk of CLABSI.\textsuperscript{12}
  
  o The risk of infection with PICCs in ICU patients approaches that of CVCs placed in the subclavian or internal jugular veins. \textsuperscript{12}

  o The majority of CLABSIs due to PICCs occur in non-ICU settings. The PICC-associated CLABSI risk may be different outside the ICU. \textsuperscript{12}

\textsuperscript{12}Marschall et al. Strategies to Prevent Central Line-Associated Bloodstream infections in Acute Care Hospitals:2014 Update. Infection Control and Hospital Epidemiology. 2014 Vol 35 No S2: S89-S107
<table>
<thead>
<tr>
<th>Key CVAD Patient Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Status of bleeding</td>
</tr>
<tr>
<td>• Status of ability to cooperate</td>
</tr>
<tr>
<td>• Status of position for insertion and removal</td>
</tr>
<tr>
<td>• Status of neck and chest</td>
</tr>
<tr>
<td>• Status of breathing</td>
</tr>
<tr>
<td>• Status of hemodynamics</td>
</tr>
<tr>
<td>• Risk of infection with placement site</td>
</tr>
</tbody>
</table>
COMPLICATION MANAGEMENT

In-dwelling Catheter Risks Considerations
# In-dwelling Catheter Complications

<table>
<thead>
<tr>
<th>HAC(^8/) non-HAC</th>
<th>PICC</th>
<th>CICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLABS(^8)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Air Embolism(^8)</td>
<td>Not Listed</td>
<td>X</td>
</tr>
<tr>
<td>Thrombosis</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Phlebitis</td>
<td>X</td>
<td>Not Listed</td>
</tr>
<tr>
<td>Wound Dehiscence</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>


\(^8\)Hospital-Acquired Conditions and Present on Admission Indicator Reporting Provision. Centers for Medicare & Medicaid Services. ICN 901046 September 2014
DVT – PICC size & Patient Factors

PICC Size
- 4 French
- 5 French
- 6 French

Patient Factors
- Cancer
- Prior VTE
- Prior Surg. (>1hr)

Less risk of DVT
Greater risk of DVT

In a prospective study, 136 PICC patients were monitored for VTE based on Catheter-to-Vein ratio:

<table>
<thead>
<tr>
<th>Catheter-to-vein ratio:</th>
<th>18% to 45%</th>
<th>≥ 46%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of PICCs</td>
<td>111</td>
<td>25</td>
</tr>
<tr>
<td># of VTEs</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Relative Risk of VTE (p=0.022)

- No VTE: 0.9%
- VTE: 12%

Reducing Risks
Reducing DVT Risk in PICC patients

Virchow’s Triad

Hypercoagulability (Blood clots are likely to form)
Stasis (Decreased blood flow)
Vessel Injury

DVT Risk

Proper Patient Selection
Minimizing Blood Flow Reduction
Minimizing Endothelial Injury

Highest DVT Risk
Managing for the Highest DVT Risk in PICC Patients

<table>
<thead>
<tr>
<th>Factor</th>
<th>Potential Causes</th>
<th>Recommendations</th>
<th>Practice Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypercoaguability</td>
<td>• Disease state</td>
<td>• Patient Selection&lt;sup&gt;22&lt;/sup&gt;</td>
<td>• Alternative VAD knowledge&lt;sup&gt;22&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• Patient Condition</td>
<td>• Daily line surveillance for need&lt;sup&gt;22&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Stasis</td>
<td>• Catheter to vein size</td>
<td>• Vessel Selection&lt;sup&gt;21,22&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Vessel Injury</td>
<td>• Multiple needle sticks</td>
<td>• Ultrasound&lt;sup&gt;21,22&lt;/sup&gt;</td>
<td>• Ultrasound&lt;sup&gt;21,22&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>• Multiple devices</td>
<td>• Modified Seldinger Technique&lt;sup&gt;21,22&lt;/sup&gt;</td>
<td>• 21 ga introducer needle, guidewire,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Catheter tip confirmation in the</td>
<td>dilator/sheath&lt;sup&gt;21&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lower 1/3 of the SVC/CAJ&lt;sup&gt;21,22&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Catheter securement&lt;sup&gt;21,22&lt;/sup&gt;</td>
<td>• ECG tip confirmation&lt;sup&gt;21&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>21</sup> Emoli et al. SIP (Safe Insertion of PICCs) protocol: a bundle of 8 recommendations to minimize the complications of the peripherally inserted central catheter. GaVeCeLT 2014

<table>
<thead>
<tr>
<th>Attribute</th>
<th>PICC</th>
<th>CICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Sizes &amp; Configurations</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Multiple Indications for Use</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Insertion Complication Risks (Hospital Acquired Condition Reportables)</td>
<td>CLABSI</td>
<td>Pneumothorax, Air Embolism, CLABSI</td>
</tr>
<tr>
<td>Patient Position Specific</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Tip Confirmation</td>
<td>ECG or CXR</td>
<td>CXR</td>
</tr>
<tr>
<td>Contemporary Composite In-dwelling Complication Rates (ICU for DVT and CLABSI)</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Short or Long Term Usage</td>
<td>Both</td>
<td>Short</td>
</tr>
<tr>
<td>Continuum of Care Usage</td>
<td>In/Outpatient, Alt. Care</td>
<td>Inpatient</td>
</tr>
<tr>
<td>Cost of Insertion</td>
<td>Generally lower than CICCs</td>
<td>Generally higher than PICCs</td>
</tr>
</tbody>
</table>

8 No significant difference in DVT rates, p=0.685.
8 Hospital-Acquired Conditions and Present on Admission Indicator Reporting Provision. Centers for Medicare & Medicaid Services. ICN 901046 September 2014
Critical Care Patient Considerations

1. **Complication Management**
   a. Are you responsible for HAC reportable events?
   b. Will the least invasive device reduce the risk of complications while delivering the required IV therapy?
   c. Is reducing the number of devices a benefit or a risk?

2. **Length of Stay**
   a. Is it predictable?
   b. Has the continuum of care been considered?
   c. Is reducing the number of devices a benefit or a risk?
   d. Is patient satisfaction important?

3. **Economic and Placer Considerations**
   a. How is your expertise being best utilized?
   b. Can a less invasive device placed by a nurse with similar risk meet the needs of monitoring the patient and delivering their IV therapy?
References

2. Teleflex™, Arrow™ Pressure Injectable CVC Brochure 1-2013
References

References


21. Emoli et al. SIP (Safe Insertion of PICCs) protocol: a bundle of 8 recommendations to minimize the complications of the peripherally inserted central catheter. GaVeCeLT 2014.


