Early Assessment & Device Selection


Mike Brazunas, BSN, RN, VA-BC
Disclosures

• Angiodynamics Inc., Latham, NY, USA
• Presidential Advisor, AVA
Objectives

• Discuss vascular access early assessment
  – Influencing factors of device selection
  – Research landscape
  – Review current guidelines

• Review device selection options

• Identify standards, guidelines and controversies related to midline catheters
We’ve gravitated towards using this device [PICC] over central venous catheters for good reasons, and it may still be the best choice for some people. However, our findings suggest that patients and physicians should carefully review the risks and benefits when it comes to placing PICCs, especially with respect to blood clots. Our study shows that this risk may be higher than previously recognized and suggests that there is no one-size-fits-all approach when considering use of these devices. – Vineet Chopra, MD
Factors Impacting Vascular Access Device Selection

- Patient Satisfaction
- CLA-BSI Reporting
- Affordable Care Act
- Improved Technology
- Evidence-Based Practice
- Infusion Needs
Affordable Care Act

The Patient Protection & Affordable Care Act (ACA) is predicated on IMPROVING, more specifically continually improving PATIENT SATISFACTION and continually improving OUTCOMES over time. The hospitals that can achieve this going forward will be the most successful.
Institute for Healthcare Improvement: Triple Aim Initiative

- Better Care for Individuals
- Better Health for Populations
- Lower Per Capita Healthcare Costs
Vascular Device Complications

Inevitable

Preventable

Acceptable
Early Assessment
“Reports spanning the past four decades have consistently demonstrated that risk for infection declines following standardization of aseptic care and that insertion and maintenance of intravascular catheters by inexperienced staff might increase the risk for catheter colonization and CRBSI. **Specialized ‘IV Teams’ have shown unequivocal effectiveness in reducing the incidence of CRBSI, associated complications, and costs**\(^2\). -CDC 2011

Designated teams have been reported to\(^8\):

- Improve first Peripheral IV success
- Improve patient satisfaction
- Decrease blood stream infections, occlusions, and accidental removals
- Decrease cost associated with complications
- ...and should be considered for insertion, management and removal of vascular access devices
Early Assessment Essentials

- **Vascular Access**: Requires timely assessment, planning, insertion and follow up.
- **Evidence**: Suggests clinical pathways improve outcomes.
- **Intentional Early Assessment**: Should be considered on admission.
- **Consider**: Proactive vs. reactive approach.
- **Appropriate Device Selection**: Can impact length of stay and complications.
- **Unfortunately**: Appropriate device selection usually happens just before discharge.

Cost Reduction and improved patient satisfaction can be a result of appropriate selection.

Indications to consider for device selection

- Based on prescribed therapy
  - Osmolarity and pH of infusates
- Duration of treatment
- Vascular integrity – vein preservation
- Patient specific information
  - Age
  - Comorbidities
  - Infusion/Device history
  - Preference for device location
- Patient satisfaction
- Least invasive access in high-risk patients
- Diagnostic needs
- Resources available to insert and care for the device
Understanding Osmolarity

The osmotic activity of a solution may be expressed in terms of either its osmolarity or its osmolality. **Osmolarity** refers to the osmolar concentration in 1 liter (L) of solution (mOsm/L) and **Osmolality** is the osmolar concentration in 1 kilogram (kg) of water (mOsm/kg of water). The terms are often used interchangeably.

<table>
<thead>
<tr>
<th>Isotonic Solutions</th>
<th>Hypotonic Solutions</th>
<th>Hypertonic Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osmolarity 280-300 mOsm/L</td>
<td>Osmolarity &lt;280 mOsm/L</td>
<td>Osmolarity &gt; 300 mOsm/L</td>
</tr>
<tr>
<td>Used to expand extracellular fluid compartment</td>
<td>Water moves from the vascular space into the cells</td>
<td>Pulls water from the interstitial space into blood vessels</td>
</tr>
<tr>
<td>Normal Saline Lactated Ringers</td>
<td>0.45% NaCl 0.33% NaCl</td>
<td>TPN</td>
</tr>
</tbody>
</table>
Understanding pH

✓ pH reflects the acidity or alkalinity of a solution
✓ Many solutions have a pH of 5
✓ Acidity of solutions allows them to have a longer shelf life
Current Recommendations for Osmolarity & pH$^{8,13}$

Do not use peripheral catheters or midlines for continuous vesicant therapy, parenteral nutrition, or infusates with an osmolarity > 900 mOsm/L (V)$^{8}$

Note: Compared to the 2011 guidelines the pH guidance has been removed and the osmolarity increased from > 600 to >900 mOsm/L

Putting it together: Based on extensive literature review, the risk of placing a central venous catheter specifically because of the pH of a medication may be greater than the risk of administering medications with a pH <5 or >9. The decision to place a central venous catheter should be based on more than pH alone.$^{13}$
# Strength of the Body of Evidence

<table>
<thead>
<tr>
<th>Strength of the Body of Evidence</th>
<th>Evidence Description*</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Meta-analysis, systematic literature review, guideline based on randomized controlled trials (RCTs), or at least 3 well-designed RCTs.</td>
</tr>
<tr>
<td>I A/P</td>
<td>Evidence from anatomy, physiology, and pathophysiology references as understood at the time of writing.</td>
</tr>
<tr>
<td>II</td>
<td>Two well-designed RCTs, 2 or more multicenter, well-designed clinical trials without randomization, or systematic literature review of varied prospective study designs.</td>
</tr>
<tr>
<td>III</td>
<td>One well-designed RCT, several well-designed clinical trials without randomization, or several studies with quasi-experimental designs focused on the same question. Includes 2 or more well-designed laboratory studies.</td>
</tr>
<tr>
<td>IV</td>
<td>Well-designed quasi-experimental study, case-control study, cohort study, correlational study, time series study, systematic literature review of descriptive and qualitative studies, or narrative literature review, psychometric study. Includes 1 well-designed laboratory study.</td>
</tr>
<tr>
<td>V</td>
<td>Clinical article, clinical/professional book, consensus report, case report, guideline based on consensus, descriptive study, well-designed quality improvement project, theoretical basis, recommendations by accrediting bodies and professional organizations, or manufacturer directions for use for products or services. Includes standard of practice that is generally accepted but does not have a research basis (eg, patient identification). May also be noted as Committee Consensus, although rarely used.</td>
</tr>
<tr>
<td>Regulatory</td>
<td>Regulatory regulations and other criteria set by agencies with the ability to impose consequences, such as the AABB, Centers for Medicare &amp; Medicaid Services (CMS), Occupational Safety and Health Administration (OSHA), and state Boards of Nursing.</td>
</tr>
</tbody>
</table>

*Sufficient sample size is needed with preference for power analysis adding to the strength of evidence.*
Medical History & Considerations

Current and Past Medical History
- Diagnosis
- Surgical History
- Previous vascular access devices
- Lab results (Coags, WBC, Cultures)
- Imaging reports
- Allergies

Considerations Include
- Areas with pain on palpation
- Veins that are compromised (bruised, infiltrated, phlebitic, sclerosed, or corded)
- Chronic Kidney Disease
- Consider vessel size- Measure vein diameter using ultrasound and consider choosing a catheter with a catheter-to-vein ratio of 45% or less
Special Considerations

**Chronic Kidney Disease**
Patients with chronic kidney disease have unique considerations.
- Fistula First Campaign
- KDOQI Guidelines

**Cancer Patient**
Higher rate of thrombosis
- Early device selection impacts therapy
- Immune compromised
- Treatment risk factors

**Pediatric**
Developmental and physiological considerations to complicate disease states.
- Parents
- Smaller vessels
- Smaller devices
What About the Patient’s Perspective\textsuperscript{3,17}

- Patient perspective is often ignored
- Patients must be given the opportunity to evaluate device options in view of their lifestyle and ability, and willingness to perform maintenance
- Patient perspective is critical in developing a Early Assessment Screening Program
- Meeting the patients physical and psychological needs is becoming more important
4 A’s of Early Vascular Access Assessment

**Assess**
Previous history and advocate for the best line choice for treatment

**Action**
Plan for the right insertion at the right time using guidelines and best practice

**Access**
Place device using tools for image guidance, accuracy and as recommended for best practice

**Accountability**
Track outcomes

Early Vascular Access Assessment

ANGPT 228 GL Rev 01
Device Selection
INS Standards 2016

- Indications & protocols for VADs shall be established in organizational policies, procedures &/or practice guidelines.

- The appropriate type of catheter (peripheral or central) to accommodate the patient’s vascular access needs based on prescribed therapy or treatment regimen, length of treatment, duration of dwell, vascular integrity, patient preference & ability & resources available to care for the device.

- Select smallest outer diameter, with the fewest number of lumens, and the least invasive device needed to achieve the prescribed therapy.
The panel evaluated 665 scenarios related to the use of Peripheral IV, US-Guided Peripheral IV, Midline, PICC, Non-tunneled CVC, Tunneled CVC, and Implanted Ports and rated the appropriateness of each device with conclusions as follows:

- For peripherally compatible infusions, PICC use was rated as inappropriate when the proposed duration of use was 5 or fewer days.
- Midline catheters and ultrasound guided PIV’s were preferred to PICCs for use between 6-14 days.
- In critically ill patients, non-tunneled CVCs were preferred over PICCs when 14 or fewer days of use were likely.
- In patients with cancer, PICCs were rated as appropriate for irritant or vesicant infusion, regardless of duration.
### Peripherally Compatible Infusates

**Figure 3.** Venous access device recommendations for infusion of peripherally compatible infusate.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Proposed Duration of Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤5 d</td>
</tr>
<tr>
<td>Peripheral IV catheter</td>
<td>No preference between</td>
</tr>
<tr>
<td></td>
<td>peripheral IV and US-guided</td>
</tr>
<tr>
<td></td>
<td>peripheral IV catheters</td>
</tr>
<tr>
<td></td>
<td>for use ≤5 d</td>
</tr>
<tr>
<td>US-guided peripheral IV catheter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>US-guided peripheral IV</td>
</tr>
<tr>
<td></td>
<td>catheter preferred to</td>
</tr>
<tr>
<td></td>
<td>peripheral IV catheter</td>
</tr>
<tr>
<td></td>
<td>if proposed duration is</td>
</tr>
<tr>
<td></td>
<td>6–14 d</td>
</tr>
<tr>
<td>Nontunneled/acute central venous</td>
<td></td>
</tr>
<tr>
<td>catheter</td>
<td>Central venous catheter</td>
</tr>
<tr>
<td></td>
<td>preferred in critically</td>
</tr>
<tr>
<td></td>
<td>ill patients or if</td>
</tr>
<tr>
<td></td>
<td>hemodynamic monitoring is</td>
</tr>
<tr>
<td></td>
<td>needed for 6–14 d</td>
</tr>
<tr>
<td>Midline catheter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Midline catheter preferred</td>
</tr>
<tr>
<td></td>
<td>to PICC if proposed duration is ≤14 d</td>
</tr>
<tr>
<td>PICC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PICC preferred to midline</td>
</tr>
<tr>
<td></td>
<td>catheter if proposed</td>
</tr>
<tr>
<td></td>
<td>duration of infusion is</td>
</tr>
<tr>
<td></td>
<td>≥15 d</td>
</tr>
<tr>
<td>Tunneled catheter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PICC preferred to tunneled</td>
</tr>
<tr>
<td></td>
<td>catheter and ports for</td>
</tr>
<tr>
<td></td>
<td>infusion 15–30 d</td>
</tr>
</tbody>
</table>

**IV = intravenous; PICC = peripherally inserted central catheter; US = ultrasonography.**
### Non-peripherally Compatible Infusates

**Figure 4.** Venous access device recommendations for infusion of non-peripherally compatible infusates.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>≤5 d</th>
<th>6–14 d</th>
<th>15–30 d</th>
<th>≥31 d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral IV catheter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US-guided peripheral IV catheter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nontunneled/acute central venous catheter</td>
<td></td>
<td>Central venous catheter preferred in critically ill patients or if hemodynamic monitoring is needed for 6–14 d</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midline catheter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PICC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunneled catheter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Appropriate**
- **Neutral**
- **Inappropriate**
- **Disagreement**

IV = intravenous; PICC = peripherally inserted central catheter; US = ultrasonography.
# Difficult Venous Access

**Figure 5. Venous access device recommendations for patients with difficult venous access.**

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Proposed Duration of Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤5 d</td>
</tr>
<tr>
<td>Peripheral IV catheter</td>
<td>No preference between peripheral IV and US-guided peripheral IV catheters for use ≤5 d</td>
</tr>
<tr>
<td>US-guided peripheral IV catheter</td>
<td>US-guided peripheral IV catheters preferred to peripheral IV catheters if proposed duration is 6–14 d</td>
</tr>
<tr>
<td>Midline catheter</td>
<td>Midline catheters preferred to PICC if proposed duration is ≤14 d</td>
</tr>
<tr>
<td>Nontunneled/acute central venous catheter</td>
<td>Central venous catheter preferred to PICC for use ≤14 d in critically ill patients</td>
</tr>
<tr>
<td>PICC</td>
<td>Disagreement on appropriateness of PICC for durations &lt;5 d</td>
</tr>
<tr>
<td>Tunneled catheter</td>
<td>Tunneled catheter neutral for difficult IV access for use ≥15 d</td>
</tr>
<tr>
<td>Port</td>
<td></td>
</tr>
</tbody>
</table>

**Key:****
- **Appropriate**
- **Neutral**
- **Inappropriate**
- **Disagreement**

IV = intravenous; PICC = peripherally inserted central catheter; US = ultrasonography.
### Frequent Phlebotomy

**Figure 6.** Venous access device recommendations for patients who require frequent phlebotomy.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Proposed Duration of Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤5 d</td>
</tr>
<tr>
<td>Peripheral IV catheter</td>
<td>No preference between peripheral IV and US-guided peripheral IV catheter for use ≤5 d</td>
</tr>
<tr>
<td>US-guided peripheral IV catheter</td>
<td>US-guided peripheral IV catheter preferred if venous access difficult</td>
</tr>
<tr>
<td>Midline catheter</td>
<td>Midline catheter preferred to PICCs if proposed duration is ≤14 d</td>
</tr>
<tr>
<td>Nontunneled/acute central venous catheter</td>
<td>Central venous catheter preferred to PICC for use ≤14 d in critically ill patients</td>
</tr>
<tr>
<td>PICC</td>
<td>Disagreement on appropriateness of PICC for durations &lt;5 d</td>
</tr>
<tr>
<td>Tunneled catheter</td>
<td></td>
</tr>
<tr>
<td>Port</td>
<td>Ports inappropriate for frequent phlebotomy, regardless of proposed duration of use</td>
</tr>
</tbody>
</table>

**Legend:**
- **Appropriate**
- **Neutral**
- **Inappropriate**
- **Disagreement**

IV = intravenous; PICC = peripherally inserted central catheter; US = ultrasonography.
Understanding Midlines
Midline History Timeline

1950
Midlines introduced by Desert Medical

1980
Midlines re-emerge when nurses started placing PICCs at the bedside

1990s
Adverse events with anaphylaxis and phlebitis led to negative evaluations.

2010
Affordable Care Act Signed in the USA

2015
Innovation in midline devices

2016
Transparency in CLABSI reporting

ANGPT 228 GL Rev 01
PICC use and VTE\textsuperscript{20}

- Multicenter, retrospective, cohort study of 76,242 patients hospitalized at 48 Michigan hospitals
- Collaborative study with Blue Cross and Blue Shield
- 3,790 patients received a PICC
  - 876 thromboembolic events
    - 208 upper extremity
    - 372 lower extremity
    - 296 pulmonary embolism (PICC use was NOT associated with PE)

Conclusion-PICC use is associated with upper and lower extremity DVT. Weighing the thrombotic risks contended by PICCs against clinical benefits appears necessary.
Midlines in the Fight Against CLABSI

Multiple studies have cited midline programs effective in CLABSI reduction initiatives

<table>
<thead>
<tr>
<th>Reference</th>
<th>Study Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharp. et (2011). Improving antibiotic treatment outcomes through the implementation of a midline: piloting a change in practice for cystic fibrosis patients. Journal of Vascular Nursing. 29(1). P11-5</td>
<td>With the implementation of a midline program with cystic fibrosis patients they had no infection and no thrombosis during the study period.</td>
</tr>
<tr>
<td>Pathak, R., et al. (2015). The incidence of central-line associated bacteremia after the introduction of midline catheters in a ventilator unit population. Infectious Diseases in Clinical Practice.</td>
<td>Midline catheters in place of central lines decrease the rate of CLABSI in a ventilator unit. In addition, no bloodstream infections were associated with midline catheters.</td>
</tr>
</tbody>
</table>
Insertion Recommendations and Controversies

- The nurse or licensed practitioner should be competent in insertion technique, identifying potential complications, and care interventions.
- Use tourniquet to promote vessel dilation.
- Full maximum barrier precautions for midline insertion.

Therapies not appropriate for midlines include:
- Continuous vesicant therapy
- TPN
- Infusates with osmolarity > 900 mOsm/L.
Vancomycin via Midline\textsuperscript{13,24}

- Administered Vancomycin over a minimum of 60 minutes at a concentration of 4mg/ml
- Cost reduction in using midlines
- Able to draw blood from the midline catheters
- In the era of commitment to evidence-based practice, the pH recommendation requires reevaluation and a critical review. On the basis of their review, the authors conclude that pH alone is not an evidence-based indication for a central line.\textsuperscript{24}

\begin{table}[h]
\centering
\caption{Catheter Performance}
\begin{tabular}{|l|c|c|c|}
\hline
 & Midline Group & PICC Group & p-Value \\
\hline
Average catheter dwell-time & 5.8 days & 6.3 days & 0.94* \\
Range dwell-time & 1-12 days & 1-25 days & \\
Median dwell-time & 5 days & 5 days & 0.51* \\
Total complications & 19.9% & 17.9% & 1.00' \\
Bloodstream infection & & & \\
Confirmed & 0 & 0 & \\
Suspected & 0 & 1 (3.6%) & 0.46* \\
Thrombosis & 0 & 0 & \\
Phlebitis & 0 & 0 & \\
Infiltration & 3 (10%) & 0 & 0.24* \\
Dislodgment & 2 (6.6%) & 4 (14.2%) & 0.40* \\
Leak & 1 (3.3%) & 0 & 1.00* \\
\hline
\end{tabular}
\end{table}

\textsuperscript{*Wilcoxon two-sample test.}
\textsuperscript{1}Fisher's exact test.
\textsuperscript{2}Unpaired t-test.
Vancomycin via Midline – Capras et al. (2017)$^{25}$

- 5 years of data
- 1,086 patients studied that received Vancomycin via Midline
- 4mg/mL dilution - 1g over 1 hour infusion
- Vessels of the upper arm typically used
- This represents only 10% of the patients that receive midlines (10,078 total midline patients)

<table>
<thead>
<tr>
<th>Days</th>
<th>1-6</th>
<th>7-14</th>
<th>15-25</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>488 (45%)</td>
<td>543 (50%)</td>
<td>55 (5%)</td>
<td>1086</td>
</tr>
<tr>
<td>Phlebitis</td>
<td>3 (0.3%)</td>
<td>3 (0.3%)</td>
<td>0</td>
<td>6 (0.6%)</td>
</tr>
<tr>
<td>Infiltration</td>
<td>4 (0.36%)</td>
<td>7 (0.64%)</td>
<td>2 (0.18%)</td>
<td>13</td>
</tr>
<tr>
<td>Extravasation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DVT</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BSI</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
# INS Non-Cytotoxic Vesicant List\(^{26}\)

<table>
<thead>
<tr>
<th>RED LIST</th>
<th>YELLOW LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-recognized vesicants with multiple citations and reports of tissue damage upon extravasation</td>
<td>Vesicants associated with fewer published reports of extravasation; published drug information and infuse characteristics indicate caution and potential for tissue damage</td>
</tr>
<tr>
<td>Calcium chloride</td>
<td>Acyclovir</td>
</tr>
<tr>
<td>Calcium gluconate</td>
<td>Amiodarone</td>
</tr>
<tr>
<td>Contrast media - nonionic</td>
<td>Arginine</td>
</tr>
<tr>
<td>Dextrose concentration ≥ 12.5%</td>
<td>Dextrose concentration ≥ 10% to 12.5%</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>Mannitol ≥ 20%</td>
</tr>
<tr>
<td>Dopamine</td>
<td>Nafcillin</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>Pentamidine</td>
</tr>
<tr>
<td>Norepinephrine</td>
<td>Pentobarbital sodium</td>
</tr>
<tr>
<td>Parenteral nutrition solutions exceeding 900 mOsm/L</td>
<td>Phenobarbital sodium</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>Potassium ≥ 60 mEq/L</td>
</tr>
<tr>
<td>Phenytoin</td>
<td>Vancomycin hydrochloride</td>
</tr>
<tr>
<td>Promethazine</td>
<td></td>
</tr>
<tr>
<td>Sodium bicarbonate</td>
<td></td>
</tr>
<tr>
<td>Sodium chloride ≥ 3%</td>
<td></td>
</tr>
<tr>
<td>Vasopressin</td>
<td></td>
</tr>
</tbody>
</table>
De-clotting Midlines

Cathflo is the only lytic:
- FDA approved for the restoration of function to central venous access devices
- Available in a single-use, 2-mg vial
- With an efficacy and safety profile in adult and pediatric patients

Indication
Cathflo® Activase® (alteplase) is indicated for the restoration of function to central venous access devices as assessed by the ability to withdraw blood.

Safety Information
Before you start exploring, please read the Important Safety Information. Download full Prescribing Information.
Ultrasound guided midline catheters are a cost-effective alternative for patients in the ICU with difficult IV access. Successful placement can help facilitate early central line removal and thus may reduce CLABSI rates.
Summary

Right Patient • Right Time • Right Line

• Establishment of early assessment programs are essential to ensure patients vascular access needs are met throughout the continuum of care
• Understanding device options, risks and outcomes specific to your hospital is critical
References


References


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