Pediatric & Neonatal CVCs:


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Disclosures

• Meghan Meehan
  • No financial disclosures
  • CVC Nurse Consultant at Children’s Hospital Los Angeles

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  • Clinical Educator for Argon Medical Devices
  • Consultant for C. R. Bard
  • Speaker’s bureau Salveo Healthcare
  • Advisory Board for IV Watch
Objectives

• Discuss the indications for the use of CVCs in neonatal and pediatric patients.

• Describe the methods of insertion for common neonatal and pediatric CVCs.

• Understand the risks, benefits and unique characteristics of commonly used neonatal and pediatric CVC.

• Discuss the rationale for utilizing clinically supported guidelines to determine the appropriateness of catheter selection.
**Definition**

Distal tip of catheter terminates:

<table>
<thead>
<tr>
<th>Placed via Upper Extremities, Chest &amp; Neck</th>
<th>Placed via Lower Extremities</th>
</tr>
</thead>
<tbody>
<tr>
<td>In lower 1/3rd of the SVC, at or near the cavoatrial junction (CAJ)</td>
<td>In IVC above diaphragm &amp; below RA</td>
</tr>
</tbody>
</table>

Source: Cathflo.com
Indications for Central Venous Access

- Medications
- High risk infusates
  - Parenteral Nutrition (PN), vesicants, irritants, certain chemotherapies
- Frequent blood sampling
- Frequent blood products
- Poor or difficult venous access
- Long term therapy
- Hemodynamic monitoring
- Dialysis/Hemofiltration/Apheresis
Contraindications & Considerations

• Relative Contraindications:
  • Coagulopathy (INR >1.5, Platelets <50k)
  • Infected or impaired skin integrity at insertion site
  • Presence of fracture, tumor or recent surgery close to insertion site

• Considerations:
  • Recent CLABSIs
  • Presence of neutropenia
  • Known vessel abnormalities
  • History of difficult insertion
  • Need for future access (including dialysis)
  • Anticoagulation status
CVC/PICC Insertion Process

- Obtain order & verify need
- Review chart & focused H&P
- Obtain consent & supplies
- Prepare patient & environment
- Perform PICC insertion
- Obtain X-ray and approval for use
CVC/PICC Insertion Commonalities

**Insertion techniques**
- Landmark vs palpation/visualization
- Ultrasound for visualization
- (Modified) Seldinger Technique

**Tip location**
- Verify tip prior to infusing!
- X-ray / fluoroscopy
- SVC/CAJ/IVC
- Future for peds: ECG tip verification
CVC/PICC Insertion: MBP

Maximum barrier precautions

• Mask, cap
• Surgical scrub
• Sterile gown
• Sterile gloves
• Site prep
• CVC/PICC Insertion bundle
• Full body drape
# PICC versus Surgical CVCs

<table>
<thead>
<tr>
<th></th>
<th>PICC</th>
<th>Surgical CVCs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inserters</strong></td>
<td>Specialty trained nurses, Vascular Access specialists, IR</td>
<td>MDs: Critical Care, Surgeons, Interventional Radiologists; PAs &amp; NPs</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>Bedside (inpatient/outpatient/ED), OR, IR, Sedation suite</td>
<td>Temporary: ICU, ED, Permanent (tunneled, cuffed): OR or IR suite</td>
</tr>
</tbody>
</table>
| **Veins Cannulated** | *Arm*: basilic, brachial, cephalic  
*Leg*: femoral, saphenous, popliteal  
*Neonate*: + scalp & median cubital | IJ, EJ, Subclavian, Axillary, Femoral |
| **Cuff present**     | No                                        | Temporary/non-tunneled: No  
Permanent: Yes |
Central Venous Catheter Placement w/ Seldinger Technique

Sel·din·ger tech·nique (sel'ding-gër), a method of percutaneous insertion of a catheter into a blood vessel or space. A needle is used to puncture the structure and a guidewire is threaded through the needle; when the needle is withdrawn, a catheter is threaded over the wire; the wire is then withdrawn, leaving the catheter in place.

<table>
<thead>
<tr>
<th>Equipment:</th>
<th>Insertion Risks:</th>
<th>Patient Positioning:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Anesthetic</td>
<td>• hematoma</td>
<td>• 15-30 degrees Trendelenberg</td>
</tr>
<tr>
<td>• Finder needle</td>
<td>• pneumothorax</td>
<td>• Head rotated towards contralateral side</td>
</tr>
<tr>
<td>• Guidewire</td>
<td>• air embolism</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Vein dilator</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Small Scalpel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Catheter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ultrasound</td>
<td></td>
</tr>
</tbody>
</table>

**Use of Ultrasound:**
- minimizes time to cannulation
- Decreases risk of arterial puncture
Vessel Cannulation & CVC Placement w/ Seldinger Technique

1. Administer 1% lidocaine w/ 25 gauge needle to insertion site
2. Access target vessel with finder needle
3. Advance guidewire through needle
4. Remove needle while stabilizing guidewire
5. Nick skin & insert dilator over wire, opening path to vein
6. Thread catheter over guidewire
7. Remove guidewire
Vessel Cannulation & CVC Placement w/ Seldinger Technique

Source: https://www.youtube.com/watch?v=BtxLOV6kSkM&list=PLD_PQdrNYoLZeRM157OjIUdS9OZbf5LuU
Link: https://www.youtube.com/watch?v=p-OTyzQ2B4A
Vascular Access Devices

Non-tunneled
- Apheresis & Dialysis
- Umbilical Catheters

Tunneled
- Implanted Port
- PICC

Midline Catheter
## Non-tunneled / Temporary

<table>
<thead>
<tr>
<th><strong>Features</strong></th>
<th><strong>Benefits</strong></th>
<th><strong>Risks/ Considerations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Single or multi lumen</td>
<td>• Provides reliable emergency access for critically ill children</td>
<td>• High risk for infection</td>
</tr>
<tr>
<td>• Non-cuffed</td>
<td></td>
<td>• Plan for prompt removal once additional access established if placed without MBPs</td>
</tr>
<tr>
<td>• Common in acute care settings/ emergency situations</td>
<td></td>
<td>• Catheters via subclavian or IJ require Xray verification prior to infusion</td>
</tr>
<tr>
<td>• Short term: Indicated for &lt; 7 days</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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</thead>
<tbody>
<tr>
<td>• Percutaneous insertion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• IJ, Subclavian, Femoral</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tunneled/Cuffed

Features
• Silicone or polyurethane
• SL, DL, TL options in varying sizes/lumen diameters
• Tissue scars around cuff
• Cared for by families

Placement Locations
• Chest is common
• Alternatives:
  • back, abdomen & thigh

Synthetic cuff inhibits migration of organisms
Tunneled/ Cuffed

Source: https://www.youtube.com/watch?v=nhCuebdcTEI
https://www.youtube.com/watch?v=Z4hCRTY2c6Q
Tunneled/ Cuffed

Benefits
• Reliable access for daily needs
• Silicone options suitable for ethanol lock
• Repairable options
• Option for needle-phobic pts
• Ideal for long-term pts:
  • PN dependent, frequent blood draws, Oncology, Hemophilia
• Cuff prevents migration of microorganisms from exit site into bloodstream

Risks
• Surgical placement
• Requires daily care
• Weekly dressing changes
• Catheter damage
Dialysis

- Large bore (8 – 16 Fr) catheter w/ staggered tips
- Allow for extracorporeal blood flow
- Temporary or permanent
- Typically placed R-IJ
- Subclavians avoided
- Terminates in R atrium
- Bridge catheter until fistula/graft/peritoneal catheter or renal transplant
- High flow caps often used
Apheresis

α·phaer·e·sis (əˈferəsəs), the removal of blood plasma from the body by the withdrawal of blood, its separation into plasma and cells, and the reintroduction of the cells, used especially to remove antibodies in treating autoimmune diseases.

Dialysis-like catheter utilized for:
• Plasmapheresis
• Photopheresis
• Peripheral blood stem cell (oncology)

Features/Options:
• Silicone & polyurethane
• SL, DL, TL
• Cuffed or uncuffed
• IJ, Subclavian or Femoral placement
• May use high flow caps
Implanted Port

- Internal tunneled catheter w/ self-sealing silicone septum
- Port pocket created in subcutaneous tissue
- Accessed by nurses
- Requires non-coring access needle
- May withstand approx 1K-3K punctures
- Varying sizes, materials & features
- Power injectable & high flow options
Implanted Port
Implanted Port

**Benefits**
- Appropriate for intermittent therapy
- Allows for active lifestyle
- Lower risk of infection
- Topical numbing agent used prior to access

**Placement Locations**
- Upper chest most common
- Lateral (torso, mid-axillary line)
- Abdomen, leg
- Arm

**Risks**
- Sludge in reservoir
- Potential for flipping
- Skin erosion
- Catheter disconnection
- Needle dislodgement

**Considerations**
- Avoid in obese patients
- Place away from breast tissue
- May require time for healing
- Do not access if overlying tissue is impaired
- Requires q month flushing
Umbilical Venous Catheters

- Indications
- Benefits
- Risks
- Complications
- Unique Features

http://www.neoknowledge.org/uvcuac/
What is an umbilical vein catheter (UVC)?
- A catheter inserted through the umbilical vein for administration of fluids, medications or blood draws.

When is a UVC indicated?
- Initial central venous access in very low-birthweight infants
- Emergency vascular access in a re-admitted newborn
- Exchange transfusion

What size catheter should be used?
- A 3.5 Fr for a neonate weighing < 3.5 kg (7.7 lbs)
- A 5 Fr for an infant weighing > 3.5 kg (7.7 lbs)
Umbilical Venous Catheters

• What are the benefits of a UVC?
  • Reliable initial vascular access for fluids, medications and blood administration and sampling
  • Use of a UVC delays peripheral attempts allowing skin maturation

• What is the proper catheter tip location for a UVC?
  • In the inferior vena cava just above the diaphragm below the right atrium

• What are the risks/potential complications?
  • Infection
  • Catheter malposition/perforation of heart, great vessels, other organs

• What is unique about a UVC?
  • Only patent and viable for up to 1 week after birth
  • In term newborn, the umbilical vein is 2 to 3 cm in length
Neonatal Peripherally Inserted Central Catheters

- Indications
- Benefits
- Risks
- Complications
- Unique features

What is a neonatal PICC?
- A catheter inserted through a peripheral vein with its tip located in the superior vena cava or inferior vena cava for administration of fluids or medications.

When is a neonatal PICC indicated?
- Transitioning from umbilical catheters
- Prolonged need for intravenous nutrition or medications
- Osmolarity > 600 mOsm/L for > 6 days

What size catheters can be used?
- Neonatal appropriate sizes range from 1.0 Fr to 3.0 Fr
• What are the benefits of a PICC?
  • Reliable long-term access for fluids, medications and blood administration and sampling (catheters 3.0 Fr or larger)
  • Use of a UVC delays peripheral attempts allowing skin maturation
• What is the proper catheter tip location for a PICC?
  • In the superior vena cava (upper extremity, scalp)
  • In the inferior vena cava just above the diaphragm below the right atrium (lower extremity)
• What are the risks/potential complications?
  • Infection
  • Occlusion
  • Catheter malposition/perforation of heart, great vessels, other organs
• What is unique about a PICC?
  • Provides long-term access with less invasive procedural circumstances
  • Supports a culture of vein preservation for patient’s future
Peripherally Inserted Central Catheter

- Small bore catheter inserted into a peripheral vein & threaded into the SVC/IVC

Common Indications:
- Central access requires < a few months
- IV therapy > 5-7 days: vesicants & irritants (abx, chemo, short term PN)

Features/Options:
- Multiple sizes
- Antithromogenic
- Antibiotic impregnated
- Power Injectable
- Valved

Multiple benefits:
- Ease of insertion & removal
- Cost effective
- Many patients can tolerate awake
- No risk of pneumothorax

Risks:
- Catheter migration
- Small lumens may be unreliable for blood draw

Contraindications:
- Patients with or at risk for:
  - Chronic Kidney Disease (CKD) & End Stage Renal Disease (ESRD)
  - Subclavian stenosis, thrombosis
PICC Insertion

• **Insertion techniques:**
  - Through the Needle Technique
    - Large gauge needle w/ peel-away sheath
    - Less common
  - Modified Seldinger Technique
    - Similar procedure to ST
    - Utilizes dilator with a peel-away-sheath

• **Vessels used:**
  - Arm (basilic, brachial, cephalic)
  - Leg (femoral, saphenous, popliteal)
  - Scalp for neonates

• **Inserters:**
  - Vascular Access Specialists
  - NICCU: RNs, NPs, MDs
  - Interventional Radiology: MD, PAs & NPs

• **Insertion location:**
  - Bedside, OR, IR, Sedation suites, Outpatient
PICC Insertion

✓ Maximum Barrier bundle kit
  ✓ Appropriate sized PICC
  ✓ Antiseptic swabsticks
  ✓ Drapes
  ✓ Echogenic needle
  ✓ Sterile US probe cover & gel
  ✓ Lidocaine
  ✓ Securement device
  ✓ Sterile NS syringes
  ✓ Guidewire
  ✓ Tourniquet
  ✓ Gauze
  ✓ etc.

✓ Ultrasound
✓ A colleague
✓ ChildLife therapist for support & distraction for awake patients
Peripherally Inserted Central Catheter

Source: https://www.youtube.com/watch?v=eXW3yU2zIol
Link: https://www.youtube.com/watch?v=vTRDiSl5ukg
Midline Catheter

- VAD measuring 6-20 cm in length in arm vein terminating in axillary region
- **Alternative to PIV for certain indications**
  - Access needed > 6 days to a few weeks
  - Frequent blood draws, antibiotics, IV hydration
- **Features**
  - Single or dual lumen
  - Power injectable option
- **Risks/Contraindications/Considerations**
  - NOT appropriate for PN, vesicants, > D10%, etc.
  - NOT used in CKD/ESRD patients
  - May not be reliable for blood return
  - Prone to phlebitis

**Need to know:**
Looks similar to a PICC: must be easily identifiable as a non-central catheter
Considerations

Diagnoses & Comorbidities

Therapy required

Vessel health & VAD history

Patient size

Anatomical variances

Patient/Caregiver preference & abilities
Patient Specific Considerations

Risks

- CLABSI
- Thrombus

Benefits

- Consistent access
- Timely treatment
- Minimize peripheral sticks
Tools for Navigating CVC Choice & Related Decisions

- Centers for Disease Control
- Infusion Nurses Society
- Best Practice Guidelines, PediSIG (AVA)
- MAGIC Initiative
- National Kidney Foundation KDOQI Guidelines
- Society of Interventional Radiology (SIR)
- CHEST Guidelines
- Infectious Diseases Society of America
References

• Best Practice Guidelines in the Care and Maintenance of Pediatric Central Venous Catheters, 2nd Edition. (2015). Pediatric Special Interest Group of AVA.
• Infusion Nurses Society. (2016). Infusion Therapy Standards of Practice, 39(1S), 1-159.

Videos
1) Seldinger Technique: https://www.youtube.com/watch?v=BtxLQvGkSkM&index=5&list=PLD_PQdrNYoLZeRM1570JlUdS9OZbfSiuU
2) Tunneling Technique: https://www.youtube.com/watch?v=nhCuebdcTEI
3) Implanted Port Insertion: https://www.youtube.com/watch?v=qX2ljHk2JlY
4) PICC Insertion: https://www.youtube.com/watch?v=eXW3yUZzjol
Please keep me safe
Lines help save lives!