The Survival of Extremely Low Birth Weight (ELBW) neonates and critically sick neonates within the NICU has increased the need for reliable vascular access to provide parenteral nutrition and medications. The umbilical venous catheter has limited indwelling time, hence the need for a Peripheral Inserted Central Catheter (PICC) line.

Goal

- Successful placement of PICC line in an optimal confirmed by radiographic examination
- Safe infusion of Parenteral Nutrition (PN) and other hypertonic solutions
- To recognize complications associated with PICC lines
- To identify safety tips and risk reduction strategies that promote neonates' patient safety with central lines
Consider the following

- Infant overall medical condition
- Anticipated length of treatment
- Assess need for the central vascular access
- Decreased sites used for multiple IV's and pain, etc
- Condition of peripheral veins

Indications:
(Patient criteria for PICC line placement may include the following)

- Premature neonates, usually with BW < 1,500 grams (due to delay in establishing full enteral feeds)
- Infants requiring more than 5-7 days of IV access
- Infected requiring a prolonged course of antibiotics e.g. meningitis
- Gastrointestinal/surgical disorder e.g. necrotizing enterocolitis, gastroschisis or omphalocele
- Severe respiratory insufficiency
- Congenital cardiac conditions
- Infants requiring infusion of fluids or medication which are hyperosmolar or have irritant properties (e.g. dopamine, dobutamine, calcium gluconate)
- Infants with inadequate or difficult peripheral venous access

Potential Benefits of Central line (PICC) line (PICC Vs PIV)

- A PICC can stay in place for days or weeks, as needed, to provide IV treatments.
- With a PICC, there is less irritation and damage to the veins than would be caused by multiple IV insertions and IV medications.
- A PICC allows for delivery of a higher concentration of nutrients and medication.
- PIV can lead to serious IV infiltration, especially if calcium is in the IVF.
Why Central Vs Peripheral

INFUSION PURPOSE AND CHARACTERISTICS
- Medications and solutions with high osmolarities and high or low pH irritate the vein wall
- Solution Osmolarity
  - 600 mOsm/kg: High
- Commonly administered hyperosmolar solutions:
  - Parenteral dextrose concentrations > 12%
  - Parenteral nutrition
  - Ampicillin
  - Cefotaxime
  - Sodium bicarbonate
  - Phenobarbital
- pH level 9 can lead to vein irritation
- Increased irritation occurs with rapid administration and inadequate time for the blood to buffer the infusate.

UVC Vs PICC Vs BROVIAC

GOLDEN HOUR (time of birth to 60 minute of life)
- Goal for the Golden hour (what is expected in our small baby unit):
  - ABC
  - Patient respiratory status need to be addressed and managed appropriately
  - All needed measure (weight, HC, length and vitals) must be completed.
  - Line (Central line) done
  - Infobation and if needed Curosurf given
  - Isolate top and all measure needed for admission is complete by 60 minutes of life.
Golden hour (continue)

- Timing of line placement for small babies – should peripheral lines be the first line of access (placed quickly and within the golden hour) or should umbilical lines always be attempted first (may take longer)?
- PIV should be attempted first quickly then umbilical lines to follow
  - However, if PIV attempt failed after 3 attempts then should proceed with umbilical insertion

SINGLE LUMEN VS DOUBLE LUMEN CATHETERS

- Double lumen does lead to less number of IV attempts.
- By limiting the number of peripheral intravenous catheterization attempts, these patients are spared the pain and possible sequelae associated with wide fluctuations in blood pressure, heart rate, and oxygenation.
- However, double lumen have increase risk for malfunction, increase risk for infection due to two lumen to protect from every time there is break in line to change lines daily or administer meds or therapy.

Radiologic Confirmation of Catheter Positions:

- Though PICC lines have multiple benefits, they can have potentially life threatening complications. A malpositioned line substantially increase the risk of complications.
- Upper extremity: line tip should be positioned in the superior vena cava
  - Premature: about 5.0 cm ± 1 cm outside the cardiac chambers
  - Term: 1-2 cm outside the cardiac chambers
- The general consensus is that the PICC should never be within cardiac chambers.
- Lower extremity: line tip should be positioned in the inferior vena cava at the level of lumbar spine (L1-L4)
- When using the left lower limb be aware that the line can migrate into ascending lumbar vein and needs to be visualized outside the midline to be inside the inferior vena cava.
Complications:
- Incidence of major complications with PICC lines are low.
- Serious complications are associated with malpositioned lines.
- Complications can be reduced with standardized procedures for insertion and catheter care.
- Infection: Catheter related bloodstream infection (CRBSI). CRBSI is an inherent risk with any vascular device. Additional risk factors are:
  - Multiple attempts and/or manipulation of catheter
  - Contamination of the catheter hub
  - Long indwelling time, i.e., more than 3-6 weeks
  - Treatment would include removal of PICC line along with antimicrobial therapy depending on the organism isolated and clinical condition of patient.
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Complications: (continue)
- Phlebitis: may occur within 24 hours as a normal body response to the catheter. Heat, warm compresses with elevation of limb, usually help; but in severe cases, may require catheter removal.
- Catheter migration/malposition: This can occur either at insertion time or any point during catheter indwelling time. This can lead to potentially dangerous complications like pericardial or pleural effusion, cardiac arrhythmia, tissue extravasation/infiltration and thrombosis.
- Catheter dysfunction/breakage: mechanical problems with the catheter.
Consider catheter exchange or removal in the following situations:
- Damaged catheter
- Change in type or size of device needed
- Occlusion
- Malposition
- Dislodgement

Complication rates related to catheter tip placement:
- N= 1266 PICCs in 1053 patients
- Mean age 6.49 +/- 2 years
- Central (SVC, RA, IVC at/above diaphragm)
  - Central group had 3.8% of complications
- Noncentral (all other tip locations)
  - Noncentral group had 28.8% of complications
  - Patients with catheter tips in noncentral locations were 8x more likely to experience a complication!

Racadio, Doellman, Johnson, Bean & Jacobs, Pediatrics, 2001
After catheter adjusted, is a follow up x-ray required?

- Yes!
- “Verify new catheter tip location via radiologic means after all repositioning efforts”

Things to Consider before PICC Placement

- Medicate appropriately - very important
- Babies should be appropriately sedated for the procedure
- Coordinate with planned extubation or ventilatory support changes
- Coordinate with volume expansion, after fluid status optimized
- Coordinate after blood products support (PRBCs, platelets)
- Place before anticipated surgery
- Place before hypothermia protocol initiated
- Timing is everything!

First Journal Article

- Catheter Duration and Risk of CLA-BSI in Neonates With PICCs
The objection of this study is to see if the duration of PICC add risk to CLA-BSI. Prolonged catheter duration was risk factor for PICC-associated CLA-BSI. A significant daily increase in the risk of CLA-BSI after 35 days may warrant PICC replacement if access is necessary beyond that period. Data suggest that beyond 35 days, the daily risk of CLA-BSI increases by substantial 33 % per day. The substantial daily increase in risk warrant reconsideration of catheter replacement as a strategy for CLA-BSI prevention.

So What is the Cost of CLA-BSI
- It extends patient length of stay by an average of 7 days, and the attributable cost is about $30,000 per infection.
- Wow, that is huge cost that could be prevented.

What are contributing factors to pathogenesis of nosocomial CLA-BSI
- There are several factors have been showed to contribute
  - Host-related risk factors including age, immunologic immaturity, and severity of underlying disease
  - Environmental and catheter related risk factors, many of which are preventable, include:
    - Prolong catheterization
    - Poor aseptic insertion technique
    - Emergent catheter placement
    - Location of catheter
    - Frequency of catheter manipulation
    - Site dressing
    - Frequent of system entry
Current recommendation for prevention includes:

- **Best practices such as:**
  - Hand hygiene
  - Maximal barrier precaution
  - Chlorhexidine skin antisepsis
  - Optimal catheter site selection
  - Daily review of need for a central line with prompt removal of an unnecessary line.

Overall

- PICC remain an essential component of NICU care, and CLA-BSI is a serious complication. Data suggest that catheter duration is an important risk factor for PICC associated CLA-BSI in the NICU. A significant daily increase in the risk of CLA-BSI may warrant replacement of a PICC if intravascular access is necessary beyond 35 days.

2nd Journal Article

- Peripherally inserted Central Catheter tip position and risk of associated complications in neonates
319 infants was classified into SVC, IVC, BC (brachiocephalic), MC (midclavicular).

Duration of cath stay and complication profile was compared between central (SVC, IVC) vs non-central PICC.

- SVC VS IVC
- SVC VS BC
- SVC VS MC

RESULT:
- Non-central (n=116) had higher complication rate (47 vs 29%)
- Non-selective removal (45 vs 27%)
- Shorter time to complication (6.2 vs 11.4 days)
- This difference was primarily due to the complication encountered with MC group, which had the highest rate of infiltration and mechanical complications.

Conclusion: Non-central PICC are associated with higher rates of infiltration and mechanical complications when the tip is in MC region. BC catheters may have comparable outcomes to SVC in neonates.

So what is common practice at this point to reduce complications (infections, infiltrate, and mechanical complications):

1. FOLLOW THE GUIDELINE OF WHO NEEDS PICC LINE
2. PLACE PICC LINE
3. EVERYDAY DURING ROUNDS, THESE QUESTIONS NEED TO BE ASKED
   - IF OF DAYS PICC LINE IN PLACE
   - DO WE STILL NEED THE PICC LINE
   - WHAT IS THE CONTINUED NEED FOR THE PICC LINE
   - REMOVE PICC LINE ONCE FEEDS REACH 100 CC/KG/DAY
   - IV SITE CHECK SHOULD BE DOCUMENTED AT MINIMUM OF HOURLY
   - TEAM LEADER IN CHARGE PICC LINE NEED TO DAILY CHECK ON PICC LINE POSITION ON EVERY BABY THAT HAS PICC LINE
   - PICC LINE DESIRED POSITION CONFIRMED