

Newborn Critical Care Center (NCCC) Guidelines

Umbilical Lines (UAC / UVC)

GENERAL INFORMATION

Umbilical vein and/or artery catheterization is an imperative and potentially life-saving measure performed in UNC Neonatal Critical Care Unit (NCCC) for critically ill infants, both premature and term, that require timely and reliable vascular access for the administration of fluids (e.g. parenteral nutrition, crystalloid, colloid, and medications), the obtainment of laboratory values, as well as accurate and continuous blood pressure monitoring.

I. Indications for Placement

A. Umbilical Arterial Catheterization (UAC)

1. Frequent monitoring of arterial blood gases and/or blood sampling
2. Continuous monitoring of arterial blood pressure
3. Infusion of maintenance glucose/electrolytes solutions (if no venous access)
4. Exchange transfusion

B. Umbilical Venous Catheterization (UVC)

1. Emergency vascular access for fluid resuscitation and medication administration
2. Initial central venous access in extremely low-birthweight infants (ELBW)
3. Hypertonic fluid requirements
4. Vasoactive drug administration (e.g. inotropes and vasopressors)
5. Continuous monitoring of central venous blood pressure
6. Exchange transfusion

II. Insertion of Lines

A. Preferably prior to delivery, collect and set-up the necessary equipment:

1. Umbilical Catheter Insertion Tray
2. Venous and Arterial Catheters
 - a) One UAC Catheter - 3.5 Fr or 5.0 Fr single lumen catheter
 - b) One UVC Catheter - 3.5 Fr or 5.0 Fr double or single lumen catheter
 - c) Catheter Size
 - (1) For infants \leq 1500 grams, use a 3.5 Fr catheter.
 - (2) For infants $>$ 1500 grams, use a 5 Fr catheter.
3. Scalpel
4. [Chlorhexidine or Betadine as deemed appropriate by weight/gestational age](#)
****All premature infants weighing < 1000 grams ONLY USE BETADINE**
5. Two silk sutures (3-0 or 4-0)
6. Sterile gown, sterile gloves (ask provider what size), hat, and mask
7. Sterile saline syringes (or 5% Dextrose syringes for ELBWs)
8. Three way stop cocks (one three way stop cock per lumen)
9. Minimum of four 3 mL syringes
10. Two 5 mL syringes

B. Epic Orders:

1. Under Order Sets, select Neonatal Procedure Focused
2. Click on Procedural Pain/Sedation and select desired medications if indicated.
3. Click on IV Fluids and choose desired solutions if not previously ordered.
4. Order radiograph – XR Neonate Umbilical Line Placement

C. Before placing lines, ensure blood glucose and vital signs have been checked, and if necessary a peripheral IV has been placed (i.e. for hypoglycemia). **Be mindful of the time taken to perform the procedure.**

Umbilical line placement is a sterile procedure. Everyone in the pod needs to wear a hat and mask, including family members and visitors.

D. Secure infant in a position that is optimal for line placement.

1. Swaddle legs and tuck arms to prevent possible contamination of umbilical area.

E. Perform hand hygiene.

F. Identify an assistant or nurse who can be available throughout the procedure.

G. Provide sedation if indicated.

H. Perform a time-out prior to beginning the procedure, to include:

1. The RIGHT patient
2. The RIGHT procedure
3. The RIGHT site

I. Umbilicus / umbilical cord is [prepped per unit policy](#) and allowed to dry for 3 minutes

J. Placement

1. UAC

- a) High lines are placed in the descending aorta above the diaphragm and below the take-off point of the subclavian artery, with the tip optimally positioned between T6 and T9
- b) Low lines are not preferred, as they are at higher risk for displacement; however, if needed for access, low lines should be securely positioned between L3 and L4. (Attending or fellow approval needed.)
- c) Methods to calculate the **DEPTH OF INSERTION** for a high UAC:
 - (1) [Birth Weight (kg) x 3] +9
 - (2) Umbilical stump to shoulder distance + 1cm (or + 2cm in term infants)
 - (3) *For either method, make sure to account for the length of the umbilical stump.*
- d) Once inserted, lines may not be advanced **unless the field remains sterile**
- e) False Tracking
 - (1) The **artery must be dilated prior to insertion** of the catheter to prevent "false tracking," a phenomenon where the catheter tracks outside the lumen itself.

- (2) **Only attempt one of the two arteries for catheterization.** Ask an attending, nurse practitioner, or fellow prior to cannulating the second arterial lumen

2. UVC

- a) During an **emergency/resuscitation:** Advance UVC only until blood return is noted.
- b) The tip of the UVC should be located above the level of the diaphragm at the junction of the inferior vena cava and right atrium.
- c) To calculate the **DEPTH OF PLACEMENT in cm:**
(1) $[\text{UAC depth (cm)} \div 2] + 1$ **OR** $[1.5 \times \text{Birth Weight (kg)}] + 5.5$
**Remember to include the length of the umbilical stump*

K. Type of Catheter

1. UAC

- a) Use 5 Fr catheter for term infants and infants > 1500 grams.
- b) Use 3.5 Fr catheter for infants \leq 1500 grams.
- c) Use 2.5 Fr for ELBW that will not accommodate a 3.5 Fr catheter.

2. UVC

- a) Consider the number of lumens the individual patient will need
- b) Size of the catheter may be individualized based on the size of the infant.

3. Double-Lumen UVC

- a) Infants that usually should receive dual-lumen UVC access:
- (1) Congenital **Cyanotic** Heart Disease
 - (2) Persistent Pulmonary Hypertension
 - (3) Severe Meconium Aspiration Syndrome
 - (4) Hypoxic Ischemic Encephalopathy / Whole Body Hypothermia
 - (5) Significant hemorrhage / abruption
 - (6) Prolonged resuscitation
- b) Infants < 750gm or < 25 weeks' GA, consider dual-lumen UVC if:
- (1) Unable to successfully place a UAC
 - (2) Significant hemorrhage / abruption
 - (3) Prolonged resuscitation

L. Type of Fluid

1. Heparin (0.5 units/mL) should be added to all UAC and UVC fluids.

2. UAC:

- a) Blood may be infused through a UAC if there is no alternate venous access.
- b) TPN may be infused through a UAC if there is no alternate venous access.
- c) Prostaglandin E1 may be infused through a UAC if necessary, though ideally the PGE infusion should not be interrupted
- d) **Fluids / medications that should NOT be infused into a UAC**
(1) **Dopamine, Dobutamine, Epinephrine (inotropes)**

(2) **Calcium boluses**

(3) **Indomethacin / Ibuprofen Lysine**

3. UVC:

- a) Emergency, low-lying UVCs should be used only for volume (PRBCs, NS, etc) and isotonic glucose solutions.
- b) Central UVCs may be used for any type of fluid, medication and/or blood product.

M. Placement Confirmation

1. Immediately after placement and suturing of catheter(s), obtain radiograph for line placement while maintaining the sterile field.
 - a) Separate catheters **externally** on the field to allow easier differentiation on radiographs - Place UVC on the right side of the patient, and UAC on the left side of the patient.
 - b) Make sure the patient is completely supine with shoulders and hips in alignment.
 - c) Make sure all other lines and tubes are not crossing the chest, thus obscuring the visibility of the catheter tip.
 - d) Make sure the infant is not lying on anything that would obscure radiographic placement of the catheters.
2. Obtain KUB that includes the chest and lower pelvis to verify placement of lines.
 - a) **Use Vocera (*33) and ask for "Portable" to notify the radiology technician that the patient is ready for line placement x-ray.**
3. Follow each line to differentiate the UVC from the UAC so that appropriate placement may be noted. (If adjustment is needed, see below).
4. Once placement is confirmed, leave sterile field in place until nursing connects fluids.
5. POCUS may be utilized for line placement verification by trained individuals.
6. Placement may also be confirmed by trans-thoracic echocardiography.

N. Line adjustments

1. Obtain AP film for **ANY** adjustment made to the umbilical lines – there must be confirmation of final line placement
 - a) Radiology technician will usually wait as the line is adjusted – orders must be placed in Epic for all subsequent radiographs
2. Trained POCUS individuals may retract the line in real time under POCUS guidance to the appropriate final position
 - a) In this case, a final film is NOT necessary, but the procedure note must state:
 1. How much the line was withdrawn (cm)
 2. Final depth of insertion (cm)
 3. POCUS confirmed to be in appropriate position above the level of the diaphragm
3. If UVC appears low on AP film, obtain a cross-table lateral as the line may still be in appropriate placement.

4. Obtain a repeat AP radiograph 24-48 hours post insertion to monitor for migration.
 - a) If UAC and UVC catheters are both present, consider using the “XR Neonatal Umbilical Line Placement” order to ensure the correct line is adjusted.
 - b) If lines require adjustment, repeat AP / cross-table later radiographs or POCUS can be used to confirm position.
 - c) Document the line adjustment in a procedure note.

O. Securing Lines

1. After suturing the lines and confirming placement, add 1 drop of tissue adhesive (e.g. Secure Port IV) at the insertion site.
2. Inspect the infant’s buttocks and back, looking for signs of decreased perfusion that would suggest the catheter has been inadvertently placed in a gluteal or spinal artery. If these areas appear dusky, remove the catheter immediately and call the fellow or attending.

P. Considerations

1. Remove catheter(s) as soon as clinically indicated. Consider indications for PICC placement. The risk of infection from a UVC increases significantly after as few as 5 days.
2. Under most circumstances, the UAC should be removed prior to advancing enteral feeds above trophic volumes (20-30 mL/kg/day).
3. Recognize that the infection risks associated with *replacing* a UV are not known but could be substantially higher than an initial placement due to colonization of the site with bacteria over time. Discuss with fellow and/or attending before attempting.

Q. Post-Procedure

1. Providers must write a procedure note
 - a) Include in the note that tissue adhesive (e.g. Secure Port IV) was used.
2. Route the note to the supervising physician.
3. Nursing should complete the central line / CABS I documentation per unit protocol.

References:

1. Barrington KJ. Umbilical artery catheters in the newborn: effects of catheter design (end vs. side hole). Cochrane Database of Systematic Reviews 1999, Issue 1. Art. No.: CD000508. DOI: 10.1002/14651858.CD000508.
2. Barrington KJ. Umbilical artery catheters in the newborn: effects of position of the catheter tip. Cochrane Database of Systematic Reviews 1999, Issue 1. Art. No.: CD000505. DOI: 10.1002/14651858.CD000505.
3. Furdon, SA., Hogan, MJ., Bradshaw, WT., & Clark, DA. Nurses' guide to early detection of umbilical arterial catheter complications in infants. *Advances in Neonatal Care*. Issue: Volume 6(5), October 2006, p242-256.
5. CDC: Recommendations for Prevention and Control of Infections in Neonatal Intensive Care Unit Patients: Central Line-associated Blood Stream Infections: <https://www.cdc.gov/infectioncontrol/guidelines/nicu-clabsi/index.html>
6. Gordon A, Greenhalgh M, McGuire W. Early planned removal of umbilical venous catheters to prevent infection in newborn infants. *Cochrane Database of Systematic Reviews* 2017, Issue 10.
7. Sanderson, E et al. Dwell time and risk of central-line-associated bloodstream infection in neonates. *J Hosp Infect*. 2017 Nov;97(3):267-274. PMID: 28651859
8. Sharpe E, Curry S, Wyckoff M. *Peripherally Inserted Central Catheters: Guideline For Practice* 4th edition. National Association of Neonatal Nurses. 2022.
9. van Rens M, Nimeri AMA, Spencer TR, Hugill K, Francia ALV, Olukade TO, Mahmah MA. Cyanoacrylate Securement in Neonatal PICC Use: A 4-Year Observational Study. *Adv Neonatal Care*. 2022 Jun 1;22(3):270-279. doi: 10.1097/ANC.0000000000000963. Epub 2021 May 27. PMID: 34743117.
10. Wortham, BM, Gaitatzes, CG, Rais-Bahrami, K. Umbilical Artery Catheterization. In MacDonald, M. & Ramasethu, R, eds. *Atlas of Procedures in Neonatology*, 4th ed. Philadelphia, PA: Wolter Kluwer/Lippincott Williams&Wilkins; 2007.p. 157-176.
11. Wortham, BM, Rais-Bahram, K. Umbilical Vein Catheterization. In MacDonald, M. & Ramasethu, R, eds. *Atlas of Procedures in Neonatology*, 4th ed. Philadelphia, PA: Wolter Kluwer/Lippincott Williams&Wilkins; 2007. p. 177-185.