
PROGENY

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MANAGING ACCESS IN THE NEWBORN: PART 3 UMBILICAL ARTERIAL CATHETERS

The umbilical artery catheter was first used for blood gas measurement in 1959. Since then, umbilical arterial cannulation has become one of the most common procedures in the neonatal intensive care unit. For sick newborns, these catheters provide valuable information to care providers with regards to blood pressure monitoring, blood sampling for laboratory values, and monitoring for cardiovascular compromise. The umbilical arteries are smaller than the vein. They are usually thick-walled and constricted. The vessels often protrude from the cut surface of the cord. Insertion of the catheter requires the LIP to gently dilate the vessel with a small iris forceps. A single lumen catheter is used for cannulating the umbilical artery. The guidelines for catheter size are as follows: for neonates under 1.5Kg, use a 3.5F catheter; for neonates over 1.5Kg, use a 5F catheter. Ideal placement of the UAC is in the "high" position. This is defined as having the tip in the descending aorta above the diaphragm and below the left subclavian artery, with x-ray confirmation at T6-T9. The calculation for insertion depth is as follows: $\text{weight (Kg)} \times 3 + 9 = \text{cm marking at the umbilicus}$. There must be a constant infusion of IV fluids through the UAC to prevent thrombus formation. These catheters should never be Heparin-locked. Current recommendations include adding Heparin (0.25-1 unit/mL) to the IV fluids. Caregivers should assure that the infant's overall Heparin administration (including all other sources) does not exceed 50 units/Kg/day. For indwelling umbilical arterial catheters, invasive pressure monitoring is required. Any break in the tubing system can result in blood backing up into the tubing and the patient bleeding out. Pressure transducers are not optional, this is a safety issue.

INDICATIONS FOR UAC PLACEMENT

- When frequent blood sampling is needed for determining arterial blood gases, electrolyte status, and other laboratory values
- When continuous monitoring of arterial blood pressure is needed

INSERTION OF UAC

Assemble the IV fluid, tubing, and pressure transducer prior to insertion. Flush the tubing carefully, removing all air bubbles, and position the transducer at the level of the patient's midaxillary line. Measurement for the proper insertion depth should be done before placing the sterile drape. The UAC should be inserted by the LIP using sterile technique. The catheter should be flushed with normal saline prior to insertion. Assist the LIP by holding the vial of normal saline to ensure aseptic technique. If possible, obtain an x-ray to confirm placement with the sterile field intact. Once the sterile field is removed, the UAC should not be advanced. Upon confirmation of correct placement, clean the infant's abdomen with sterile water to remove any alcohol residue. Secure the catheter to the abdomen with a transparent dressing. If possible, place a hydrocolloid base layer under the transparent dressing. When blood cultures are obtained from the UAC, it is important to remove the sample aseptically *before* infusing IV fluids. Connect the transducer tubing to the stopcock, maintaining an air-tight system. Calibrate or "zero" the transducer, and observe the monitor for a normal arterial waveform. If the waveform is dampened, check the system for loose connections, air bubbles, and kinking. Ensure that the monitor scale size is set appropriately. Notify the LIP if you are unable to obtain a waveform. Begin IV fluid infusion, and set the ABP alarm parameters as appropriate for the patient's age.

NURSING DOCUMENTATION

Vital signs including arterial blood pressure should be documented *hourly* while the UAC is in place. The IV fluid rate should also be charted *hourly*. Documentation of insertion should include the time of insertion, catheter size, cm marking at the umbilicus, amount of blood removed for labs, IV fluids infusing, and patient tolerance of the procedure. Assessment of the umbilical insertion site including the cm marking at the umbilicus should be documented at least once every shift. The pressure transducer should be calibrated at insertion and every 8-12 hours thereafter. The following observations should be reported to the LIP: excess bleeding; change in the depth of insertion; and, signs of infection such as redness, edema, and purulent drainage at the umbilicus.

ARTERIAL CATHETER SAMPLING

Blood sampling from an umbilical arterial catheter has been shown to significantly decrease cerebral blood volume and cerebral oxygenation in very low birth weight infants. Abrupt cerebrovascular circulation changes can lead to intraventricular hemorrhage. The authors of one such study suggest that "sampling from and injections into umbilical artery catheters should be performed slowly and with immense caution." In a more recent study, researchers compared the effects of two different sampling speeds, 20 seconds and 40 seconds, on cerebral oxygenation in preterm infants 25-35 weeks gestation. They found a significant decrease in cerebral oxygenation with a sampling speed of 20 seconds. When the sampling time was increased to 40 seconds, no significant change in cerebral oxygenation was noted. Based on the current evidence, the recommendation from UI Children's Hospital is sampling at a rate of 1mL/30 seconds for all neonates with umbilical arterial catheters.

All blood samples should be obtained aseptically to avoid contamination. The risk for infection increases each time the line is accessed. Clean the stopcock with alcohol and allow it to dry before removing the syringe for blood sampling and tubing change.

CATHETER REMOVAL

When the indications for UAC placement no longer exist, the catheter should be promptly removed. At UI Children's Hospital, this procedure can be performed by RN's in NICU Bay 1. The procedure for removal is as follows: turn the IV fluid rate down to 0.2mL/hour, maintain the pressure transducer and monitored waveform, pull back the catheter until only 2cm remains inside the neonate, monitor the arterial waveform until it has flattened, then pull the remaining 2cm of umbilical arterial line from the patient. Stay at the patient's bedside throughout this procedure. Pressure should be held to the site for a minimum of 5 minutes, up to 10 minutes, or until the bleeding subsides. Assess for bleeding every 15 minutes for the first hour after catheter removal, and notify the LIP of excess bleeding.

POTENTIAL COMPLICATIONS

There is the potential for perforating the vessel with insertion of the catheter resulting in hemorrhage. The catheter may cause vasospasm resulting in blanching or cyanosis of the toes, feet, legs, or buttocks. This is probably the most common complication, and the risk is increased with low-lying catheters. Vasospasm may result in thrombus formation or emboli which can cause extensive ischemic injury to the lower extremities. Umbilical arterial catheters have been associated with intraventricular hemorrhage (IVH) and necrotizing enterocolitis (NEC) related to retrograde blood flow, transient increases in blood pressure (especially with a rapid sampling time), and microemboli. The catheter itself can be a source of infection for the newborn. Coagulase-negative staphylococcus is the most common organism isolated from umbilical catheters.

MANAGEMENT ISSUES AND PRECAUTIONS

At UI Children's Hospital, newborns with an umbilical arterial line are cared for on a warmer bed, and parent holding of these infants does not occur while the UAC is in place. The risk of accidental dislodgement and compromise to patients who are unstable enough to warrant the use of an umbilical arterial line outweighs the benefit of parent holding. Exceptions to this rule are made for extenuating circumstances, such as DNR status or holding prior to withdrawal of support.

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References are available upon request.