Clinical Guideline:  
Insertion of an Umbilical Arterial Catheter

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For use in: Eastern Neonatal Units  
Guidance specific to the care of neonatal patients

Used by: Medical Staff, Neonatal Nurse Practitioners and Enhanced Neonatal Nurses

Key Words: Indications, position of catheter, complications

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Audit Standards:
1. Umbilical arterial catheters (UAC) are positioned between T6-10 if a high placement or below L3 if a low placement.
2. The position of all UAC’s is confirmed with an x-ray.
3. The insertion procedure and confirmation of the position of the UAC tip is documented in the case notes.
Insertion of an Umbilical Arterial Catheter

1. Goal
To ensure the safe insertion of an umbilical arterial catheter

2. Duration of Use
Umbilical arterial catheters should remain in place only as long as a clinical indication exists\(^1,2\).

3. Indications\(^1\)
- Frequent measurement of arterial blood gases for oxygen tension (pO\(_2\))
- Continuous monitoring of arterial blood pressure
- Resuscitation (though the umbilical venous route is the first choice)
- Exchange transfusion

4. Contraindications
- Evidence of vascular compromise in the lower limbs or buttock area
- Peritonitis
- Necrotizing Enterocolitis
- Abdominal wall defects

5. Complications include\(^1\)
- **Positional:** perforation, misdirection, refractory hypoglycaemia (catheter tip opposite coeliac axis) - if a dextrose infusion is running via the catheter
- **Vascular accident:** Abdominal aortic thrombosis leading to congestive heart failure, embolism, vasospasm, loss of extremity, air embolism\(^2,3,4\)
- **Equipment related:** Breaks or knots in catheter
- **Other:** Sepsis, haemorrhage, necrotising enterocolitis, intestinal perforation, pericardial effusion

6. Physiological instability during insertion
- Closely observe the infant during and following the procedure for any deterioration
- Monitoring (ECG and oxygen saturation) should remain in place throughout the procedure
- If the infant is intubated, check the endotracheal tube is secure before commencing the procedure.
- If the infant is very preterm and is nursed in a polyethylene bag this should remain in place with a small incision made over the umbilicus to provide access.

7. Notes
- Take a little time to gently dilate the lumen of the artery before attempting to insert the catheter
- Do not allow air to enter the catheter; always ensure that the catheter is fluid-filled and that the three-way taps are in place before insertion.
- On completion of the procedure loosen the umbilical tie.
- Always obtain an x-ray to confirm position.
- Catheters that are incorrectly placed must be re-positioned. If at T12 or L1 the catheter should be withdrawn to a low abdominal position (below L3).

8. Timing of insertion
- Umbilical arteries constrict within a few minutes of birth. Closure is delayed in hypoxia and acidosis
- Successful catheterisation is most likely in the first 15-30 minutes after birth.
- It is important to ensure that the infant is warm and well oxygenated.

9. Position of the Catheter
- High placement is regarded as between T6 – T10
- Low placement below L3 (ideally between L4 & L5)
High placement is associated with a lower incidence of clinical vascular complications without an increase in any adverse sequelae. Low position catheters cause less significant changes in the cerebral blood flow velocity and thus may be safer for use in preterm neonates at risk for intraventricular haemorrhage. However they may be associated with perfusion problems to the lower limbs therefore they often do not remain in-situ for as long as the catheter in a high position.

10. Equipment
Sterile pack for UAC insertion
Sterile gloves and gown
Scalpel
Chlorhexidine 2% for skin preparation
Umbilical arterial catheter - size 3.5 or 5/6 French gauge
10ml syringe
0.9% sodium chloride 10ml ampoule
Green needle 21G
Suture 3/0 Mersilk (or equivalent)
Tape to secure the line in place with suture or umbilical catheter holder
10 ml ampoule of water for injection
Sterile cord ligature
3-way tap
11. Preparation

1. Determine the desired length of the catheter in cms using the following formula: \( \text{infant weight in Kg} \times 3 + 9 \text{cm} \) \(^{10,11}\)
   I.e. if infant weighs 1.5kg \((1.5 \times 3) + 9 = 13.5 + \text{stump}\)

   **Note:**
   - This calculated length is from the umbilical skin.
   - Add on the length of the cord stump for accurate calculation.
   - Using this calculation, the catheter should be positioned between T6 - T10.\(^*\)

2. Position the infant and surrounding equipment so that the cord is accessible

3. Where possible, depending on the urgency of the procedure ensure that infant’s temperature is at least 37\(^0\)C before starting the procedure. Check that there is adequate output from the radiant heat source or incubator to keep the infant warm during the procedure.

4. If the infant is particularly active and doesn’t calm when the drapes are in place ensure that an assistant is on hand to contain and support the infant for the procedure.

12. Procedure

1. Wash hands and prepare equipment

2. Following aseptic procedure principles put on sterile gown and gloves.

3. Draw up 10mls of 0.9% saline into syringe and flush through catheter and 3-way tap.

4. Clean cord and peri-umbilical area with chlorhexidine 2%. Avoid excess application and any spillage around down to the buttocks as this may cause burns to very preterm skin.

5. Allow to dry, then remove with sterile water to prevent adverse skin reactions\(^{12,13}\).

6. Holding the cord with sterile gauze (to prevent contamination to sterile gloves) apply the sterile drapes.

\(^*\) Alternatively, using a tape measure to measure the distance from the cord base to a shoulder and add on the stump length to give the distance that the catheter should be inserted to.
7. Tie umbilical tape around base of cord preferably around the Wharton’s jelly rather than the skin in a single knot. This needs to be tight enough to minimize blood loss but loose enough to allow the catheter to be passed through.

8. Grasp the cord with the artery forceps and gently pull the cord upwards whilst you cut the underside of the forceps with a scalpel blade.

9. Control any bleeding by gentle tension on the cord ligature. Blot the surface of the cord stump with a gauze swab, avoiding rubbing as this may damage the structures and obscure the anatomy.

10. Figure 2 Identify the vessels in the cord

11. The vein is easiest to identify, as it is large, thin-walled and sometimes gaping. It is most often found in the 12 o’clock position. The arteries are found inferiorly, are thick walled, white and may protrude slightly from the cut surface.

12. Hold the cord stump with two artery forceps (with one pair of forceps close to the vessel that is to be cannulated). Apply traction to stabilise the cord stump.

13. Carefully dilate the lumen of the artery with a dilator or fine non-toothed or iris forceps used initially to probe gently to a depth of 0.5cm.

14. Probe gently again to a depth of 1cm with the forceps or dilator.

15. Allow the points to spring apart and maintain the forceps in this position for a few seconds to dilate the vessel.

16. Keep the vessel open with the forceps or probe and prepare to insert the catheter.
17. Hold the catheter about 1cm from its tip with a pair non-toothed of forceps or between finger and thumb.

18. Place the tip of the catheter in the lumen of the vessel between the prongs of the forceps (or remove the probe just before inserting) and gently advance.

19. Pass about 2cm into the vessel with a firm steady motion until resistance is felt at the point where the umbilical artery turns upwards.

20. Hold the edge of the cord stump with the artery forceps and gently pull the stump towards the head of the infant. Mild traction will facilitate the passage of the catheter at the angle between the cord and the abdominal wall.

21. After passing the catheter about 5cm into the vessel aspirate to confirm an intraluminal position. Arterial pulsation should be seen. Flush the catheter through with saline to keep the catheter clear and turn the three-way tap off.

22. If the catheter does not want to pass through:
   - If there is resistance in the stump – loosen the cord ligature and consider re-dilating the artery
   - Popping sensation – may indicate that the catheter has exited the lumen and created a false passage. It may be necessary to access the second artery
   - Backflow of blood around the catheter or other vessels – tighten the cord ligature
   - Resistance encountered at the iliac junction (approximately 6-8cm from the surface of the stump) – apply a steady pressure for 30-60 seconds or try repositioning the infant with the same side elevated as the catheter with the hip flexed.
   - Easy insertion but no blood return – catheter is in a false passage and should be removed.

23. Advance to pre-determined length and aspirate to verify blood return.

24. **Slowly** take blood for sampling and blood gas analysis\(^\text{15}\), clearing the line with saline on completion. At this point observe the infant's lower limbs for colour and warmth.

25. Secure the catheter using a technique that avoids tape being applied to the skin if possible e.g suture and flag or Sulle securing device secured with a suture to the umbilicus\(^\text{16,17}\). Or use a colloid based umbilical catheter holder that will protect the skin e.g. Neobridge\(^\text{18}\).

26. Ensure that the catheter is secure, still bleeds back and flushes. Finally make sure that the three-way tap is turned off.
27. Check the infants’ circulation to the lower limbs

Alternate method
Instead of cutting the stump – if the arteries can be identified from side of the umbilical cord then a side approach may be used to insert the catheter.

13. Following procedure

1. Clear away all equipment, including sharps safely.

2. Obtain chest/abdominal x-ray to confirm catheter tip location. The catheter is ideally placed between T6 - T10 or below L3 (ideally between L4 - L5).

3. Any catheter that has descended to the lower limbs or gluteal region or compromises circulation must be removed immediately.

4. Connect infusion fluid of:
   - 0.45% sodium chloride if BW <1500g or hypernatremic
   - 0.45% or 0.9% sodium chloride if BW > 1500g
   - with 1 IU heparin/ml to run at 0.5ml/hour to catheter to maintain patency.

5. Ensure the catheter is clearly labelled as an umbilical artery catheter.

6. If the catheter is to be transduced, attach the transducer at the same time as connecting the infusion.

7. Record the procedure in the infant's medical notes. The entry in the medical notes must include;
   - Date and time
   - Procedure undertaken
   - Blood loss if any
   - Type and size of catheter used
   - Length of insertion
   - Confirmation of the colour of the lower limbs and buttocks, pulses are present, and that the line flushes and samples well
   - Confirmation of catheter tip position following x-ray
   - If any changes made to catheter length following x-ray, this needs to be documented in the medical notes and on the PACS image.
   - Signature printed name and designation.

8. The catheter should be removed as soon as it is no longer required to prevent complications such as thrombosis, vasospasm and infection.
References


