

Clinical Guideline: Umbilical Arterial Catheter Insertion

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

Used by:

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1) Background

Umbilical arterial catheters (UACs) are an essential part of neonatal care allowing frequent measurement of arterial blood gases for oxygen tension (pO₂) and continuous monitoring of arterial blood pressure. However, their use are associated with a number of complications, some of which can be fatal. It is therefore vital that UACs are only used: i) in infants who really require them; ii) where that the person inserting and looking after the infant with a UAC is competent and aware of the complications associated; and iii) when correct safety measures are taken to reduce the risk of complications during and following the insertion of the UAC. The British Association for Perinatal Medicine has recently published a framework for practice to reduce harm and improve safety in babies needing central venous catheters⁵. Although the focus of that document is umbilical venous catheters (UVCs) its key findings are applicable to the care of all central lines inserted within the neonatal care setting. Practice points highlighted by the BAPM expert working group have therefore been incorporated within this guideline.

2) Objective

To ensure the safe insertion of an umbilical arterial catheter.

3) Indications¹

- Frequent measurement of arterial blood gases for oxygen tension (pO₂)
- Blood sampling
- Continuous monitoring of arterial blood pressure
- Resuscitation (though the umbilical venous route is the first choice)
- Exchange transfusion

4) Contraindications²

- Abnormalities of the abdominal wall
- Necrotising enterocolitis
- Peritonitis
- Evidence of vascular compromise to lower limbs or buttocks
- Consider a Peripheral arterial line in IUGR infants with antenatal absent or reversed end diastolic flow

5) Complications¹

- 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, hypertension.

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 to the polyethylene bag over the umbilicus to provide access.

7) Key notes (Based upon the recommendations of the 2018 BAPM Framework⁵)

- In each situation where a UAC is required an assessment should be made as to who is the most appropriate person to undertake the procedure.
- A Central Catheter Care bundle should be used to covers all aspects of insertion, use and on-going management of the UAC.
- Staff inserting the UAC should have undertaken a formal training package for the insertion of central arterial catheters. This should include an assessment of technical competence and awareness of potential complications
- Staff inserting UAC have a responsibility to ensure they maintain their competence and should be familiar with the equipment and procedures used for catheter insertion.
- When inserting a UAC each UAC should be withdrawn to a point at which it freely aspirates blood (to prevent malposition) and, after being secured in position, should be x-rayed to confirm that the position is acceptable.
- Following any new manual adjustment of UAC position, irrespective of how small the adjustment, a further radiograph should always be obtained to verify the new position.
- Use of ultrasound to confirm ongoing position can be used where facilities and skill mix allows.²¹
- The UAC position should also be noted on any subsequent x-ray done in the baby
- Umbilical catheters should be clearly labelled to distinguish arterial and venous catheters.

- There should be thorough contemporaneous documentation of each UAC insertion including indication, description of the catheter itself, number of attempts, length inserted, confirmation of blood aspiration, position on X-ray, and any adjustments subsequently made. The accepted position should be verified in writing within 24 hours of insertion by a consultant neonatologist/consultant paediatrician or from a consultant radiologist's report.
- The need for continued retention/use of a UAC should be reviewed daily.
- On-going care of UAC should include regular review of catheter fixation and position, strict asepsis and minimising catheter access.
- Any clinical deterioration of a baby in whom a UAC is present should raise the question of catheter-related complications, particularly infection and extravasation.
- Parents should always be informed about the use of central catheters at the earliest opportunity, although formal prior consent is impractical.

8) 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^{6,7,8}.
- 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 position⁹.

9) Description and Documentation of the Procedure

Equipment

- Sterile pack for UAC insertion
- Sterile gloves and gown
- Scalpel
- Chlorhexidine for skin preparation¹⁰
- Umbilical arterial catheter - size 3.5 or 5/6 French gauge
- 10 mL syringe
- 0.9% sodium chloride 10 mL 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

Preparation

- Assess the depth that the catheter needs to be inserted with the following formula:

$(3 \times \text{baby's weight in kg}) + 9 \text{ cm} + \text{cord stump length in cm's}^{11,12}$

- Position the infant and surrounding equipment so that the cord is accessible.
- Where possible, depending on the urgency of the procedure ensure that infant's temperature is at least 37°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.
- 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. Consider use of sucrose if applicable.

Procedure

- Clean trolley surface
- Wash hands.
- Open the packaging of equipment with a non-touch technique.
- Wash hands thoroughly and dry.
- Put on gown and sterile gloves *in addition, hat & mask should be worn where this is local unit policy*
- Follow aseptic procedure principles.
- Draw up 10 mL of 0.9% sodium chloride into syringe and attach a three-way tap to the catheter. Flush through both the three-way tap (if used) and the catheter with the saline ensuring that there is no air in the system.
- Turn the three-way tap off or clamp the line to prevent any entry of air into the catheter to reduce the risk of air embolism whilst the catheter is being inserted.
- Clean cord and peri-umbilical area with chlorhexidine solution. Take great care to avoid excess application and any spillage around down to the buttocks or prolonged contact with the skin as this may cause burns to very preterm skin. Allow to dry, then remove with sterile water to prevent adverse skin reactions^{13, 14}.
- Holding cord clamp with sterile gauze, apply sterile drapes.

- Tie umbilical tape around the base of the cord tightly enough to minimise blood loss but loosely enough to allow the catheter to be passed through.
- 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 leaving 1-2 cm of cord above the skin junction.
- 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
- Identify the vessels in the cord. 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 (See figure 1).
- 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.
- Gently open the arterial lumen with a pair of curved forceps
- Allow the points to spring apart and maintain the forceps in this position for a few seconds to dilate the vessel.
- Carefully dilate the lumen of the artery with a dilator (maximum depth of 1 cm).
- Keep the vessel open with the forceps or probe and prepare to insert the catheter.

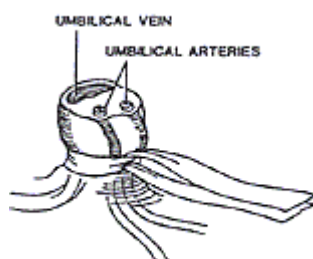


Figure 1 Picture demonstrating vessels in the cord (from 'Atlas of Procedures in Neonatology' ¹)

- Hold the catheter about 1 cm from its tip with a pair non-toothed of forceps or between finger and thumb.
- 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.
- Pass about 2 cm into the vessel with a firm steady motion until resistance is felt at the point where the umbilical artery turns upwards.
- 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.
- After passing the catheter about 5 cm 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.

- 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
 - If a popping sensation is felt it 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 6-8 cm 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 likely in a false passage and should be removed.
- Advance to pre-determined length and aspirate to verify blood return.
- Slowly take blood for sampling and blood gas analysis¹⁶ clearing the line with saline on completion. At this point observe the infant's lower limbs for colour and warmth.
- 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^{17,18}. Or use a colloid based umbilical catheter holder that will protect the skin e.g. Neobridge¹⁹.
- Ensure that the catheter is secure, still bleeds back and flushes.
- Connect the catheter to the prescribed infusion.
- Ensure the catheter is clearly labelled as an umbilical artery catheter.
- 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).
- Any catheter that has descended to the lower limbs or gluteal region or compromises circulation must be removed immediately.
- Clear away all equipment and ensure that any needles or scalpel are safely disposed of into a sharps bin.
- Record the procedure in the infants' medical notes using a dedicated UAC documentation label, such as the example in Figure 2. The UAC label should provide for the routine specific documented confirmation that there was blood sampling from the UAC at the point of catheter fixation.
- To help maintain catheter patency use heparinised saline solution (eg either 0.45% or 0.9% saline containing 1 Unit heparin per mL). Infuse at a rate of 0.5–1.0 mL/hour according to size of baby.
- Regular nursing observations of the catheter insertion site and of the external anatomical site corresponding to the catheter's internal route should be undertaken (for example using a Visual Infusion Phlebitis "VIP" scoring system). It is recommended that as a minimum hourly inspection and documentation of the state of the umbilical catheter insertion site is recorded.
- Need for the UAC should be reviewed daily. The catheter should be removed as soon as it is no longer required, to prevent complications such as thrombosis, vasospasm and, infection²⁰.

Insertion of UAC

Date:..... **Time:**.....

Indication

Insertion length: use the following method
($\{3 \times \text{weight in kg}\} + 9$) + cord stump length. cm

Length by formula:cm. Stump length: cm

Actual insertion length:cm

Confirm that line sampled blood at insertion length: (tick)

No. of attempts.....

Person undertaking catheter insertion: Name.....

Designation..... Signature

Date and time:..... Successful / Unsuccessful

Position on X-Ray: Acceptable Yes or no
If no, state action
taken:.....

Position on repeat X-Ray:..... Acceptable Yes or no

Sign below to verify line position confirmed as satisfactory by
Consultant Neonatologist/paediatrician/radiologist (within 24 hours of
insertion)

Name & Signature: Date & Time

Fig 2: Example of umbilical Arterial catheterisation sticker for document procedure in the medical casenotes.

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