

## Clinical Guideline:

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

**Used by:** Doctors and ANNPs

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Neonatal Clinical Oversight Group	
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Date of meeting	
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**Audit Standards:**

To be locally agreed.

## 1) Background

Umbilical arterial catheters (UACs) are an essential part of neonatal care allowing frequent measurement of arterial blood gases for oxygen tension ( $pO_2$ ) and continuous monitoring of arterial blood pressure. However, their use is 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 associated complications; 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 catheters<sup>5</sup>. 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) Indications<sup>1</sup>

- Frequent measurement of arterial blood gases for oxygen tension ( $pO_2$ )
- Blood sampling
- Continuous monitoring of arterial blood pressure
- Resuscitation (though the umbilical venous route is the first choice)
- Exchange transfusion

## 4) Contraindications<sup>2</sup>

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

## 5) Complications<sup>1</sup>

- Positional-perforation, misdirection, refractory hypoglycaemia (catheter tip opposite coeliac axis) - if a glucose infusion is running via the catheter
- Vascular accident- abdominal aortic thrombosis leading to congestive heart failure, embolism, vasospasm, loss of extremity, air embolism<sup>2,3,4</sup>
- 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 Framework<sup>5</sup>)

- 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 it 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.<sup>21</sup>
- 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<sup>6,7,8</sup>.
- 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<sup>9</sup>.

## 9) Description and Documentation of the Procedure

### Equipment

- Sterile pack for UAC insertion
- Sterile gloves and gown
- Scalpel
- Chlorhexidine for skin preparation (see details below)
- 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

### Antiseptic Skin Cleanser

BAPM together with the Neonatal & Paediatric Pharmacists Group (NPPG, 2021) released a position statement in response to antiseptic skin cleansing use in neonates due to reported burn injuries seen in this population. The advice is as follows:

- In babies born before 34 weeks' gestation and who are under 7 days old, use aqueous solution of 0.5% chlorhexidine gluconate for skin preparation.
- In babies born from 34 weeks' gestation onwards and for those babies born before 34 weeks' gestation who are now 7 days or older, use a solution of 2% chlorhexidine in isopropyl alcohol for skin preparation.
- Irrespective of the skin preparation solution used, it is critical to avoid pooling on the skin and surfaces (such as incubator or cot sheets) which may come into contact with the baby's skin. For this reason, the use of an applicator device is recommended wherever possible

## Preparation

- \* Assess the depth that the catheter needs to be inserted using the Neomate® app or with the following formula:

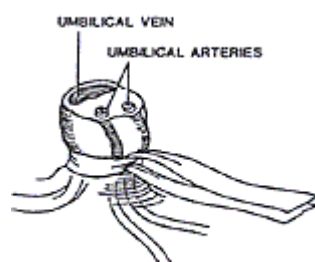
$(3 \times \text{baby's weight in kg}) + 9 \text{ cm} + \text{cord stump length in cm's}^{11,12}$

- \* Position the infant and surrounding equipment so that the cord is accessible.
- \* Where possible, depending on the urgency of the procedure, ensure that the 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 two pairs of 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 according to unit guidance. 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 following the BAPM & NPPG (2021) guidance above.
- \* Remove 1 set of sterile gloves.
- \* 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' <sup>1</sup>.)**

- Hold the catheter about 1cm 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 analysis<sup>16</sup> 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<sup>17,18</sup>. Or use a colloid based umbilical catheter holder that will protect the skin e.g. Neobridge<sup>19</sup>.
- 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 documented confirmation that there was blood sampling from the UAC at the point of catheter fixation.

## Post-Procedural Care of the UAC

To help maintain catheter patency, use heparinised saline solution (e.g., 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 the size of the 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 are recorded.

It is imperative that arterial lines are clearly labelled as arterial, to distinguish between venous and arterial catheters.

The baby should be nursed in an incubator or under a radiant heater. The umbilical site must be exposed and continually observed, so the neonate must be nursed in an intensive care area and not left unattended.

The baby should have ECG lead monitoring to check for arrhythmias and general deterioration.

The length of insertion of the UAC must be documented on a daily basis.

Standard (universal) precautions and an aseptic non-touch technique (ANTT) must be adhered to when siting, manipulating, accessing, or removing the UAC line.

Drugs and hypertonic solutions must never be given via an arterial line. This may cause spasm severe enough to obstruct all blood flow through the artery.

Only a trained and competent practitioner may withdraw blood.

Following blood sampling, always flush the line to clear any residue of blood. Otherwise, blood left in the system may clot and affect the quality of the trace. The line may also be blocked, stop working, and need to be removed.

The 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 infection<sup>20</sup>.



## UAC Removal

Removal of the UAC should be considered as soon as it is no longer required.

UACs should only be removed by a nurse or doctor trained and competent in doing so, as central venous lines have a high risk of breaking or snapping during removal.

If coagulated blood is around suture material and the umbilical stump, and to decrease snapping risk, moisten sterile gauze with sodium chloride and wrap it around the umbilical stump for 1-2 minutes.

During the removal, the umbilical cord should be held securely with forceps, and sutures should be cut, taking extreme care not to cut the catheter itself.

A second person should be present to provide a supportive hold of the infant's extremities during suture cutting and to support in the event of acute blood loss.

Artery forceps should be available at the cot side during umbilical catheter removal so that the catheter or umbilical stump can be clamped immediately in the event of acute blood loss.

The catheter should be removed in small stages, approximately 1 cm at a time, with pauses in between.

Steady and gentle traction should be used, starting at the insertion site.

Use sterile gauze to hold pressure on the umbilical stump after the catheter is removed and ensure bleeding has stopped. If oozing persists, Avitene may be applied to achieve haemostasis.

Following removal of the UAC, ensure that the catheter is complete, haemostasis has been achieved, and an adequate period of observation of the umbilicus is undertaken before placing the infant prone<sup>1</sup>.

The removal procedure should be documented in the infant's medical records, including a statement confirming that the catheter length was checked at the time of removal to ensure complete extraction.

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

### 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 &amp; Signature:

Date &amp; Time

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