GUIDELINE

Umbilical Arterial Catheter (UAC)

Scope (Staff):	Nursing and Medical Staff
Scope (Area):	NICU KEMH, NICU PCH, NETS WA

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CAHS Child Safe Organisation Commitment Statement

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Aim

Outlines the indications, insertion and management of umbilical arterial lines for the neonatal population. This guideline is to be followed in conjunction with the Central Venous Access Device Bundle for consistency of care.

Risk

Invasive devices always carry potential risk which increases when processes and management are not followed. Some of the identified complications associate with umbilical lines include:

- Catheter malposition - vessel or peritoneal perforation, movement of catheter
- Vascular complications like thrombosis, embolism/infarction, vasospasm, vascular compromise to the lower extremities.
- Hypertension
- Air embolism
- Infection
- Bleeding

Indications for Insertion

The umbilical artery begins to constrict after birth but may be cannulated up to the first week of life.

Decision to insert a UAC should be made on a case-by-case basis and discussed with the consultant or senior registrar. Indications for insertion may include:

- Requiring frequent blood sampling or blood gas monitoring
    - Preterm (<800 grams or <26 weeks)
    - Increasing oxygen requirements +/- ventilation
    - Babies undergoing therapeutic hypothermia for HIE
- Requiring blood pressure monitoring
    - Critically unwell infant
    - Infant requiring ionotropic support
- Exchange transfusion

As per the Guidelines for the Prevention of Intravascular Catheter-Related Infections (2011), Centre for Disease Control (CDC) and Prevention, where possible, a **UAC should be kept in no longer than 5 days due to the high risk for vascular and infection related complications.**

Prior to Procedure

- The clinician performing the procedure must have appropriate training or supervision during the procedure
- Documented clinical indication in the patient's progress notes and fill in MR following procedure whether successful or not.
- Adequate cardiac and saturation monitoring of the infant throughout the procedure.
- Refer to Neonatal Intravascular Device Insertion Record (MR422) for procedural checklist.
- UAC is often inserted in conjunction with an Umbilical Venous Catheter (UVC)
- Refer to CVAD Bundle for further information on insertion preparation

Anatomy and Position

Refer to Appendix 1: Anatomy and Position

Catheter Size and Insertion Distance

<1500g 3.5F – single lumen catheter

>1500g 5F – single lumen catheter

- The preferred method for estimating the insertion distance for the UAC is by measuring the umbilicus to shoulder distance.
- Measure from the skin at the base of the stump where it connects to the anterior abdominal wall.
- Add the length of the umbilical stump to the distance inserted.

Shoulder-Umbilical distance (cm)	Low UAC (cm)	High UAC (preferred) (cm)
9	5	9
10	5.5	10.5
11	6.5	11.5
12	7	13
13	7.5	14
14	8.5	15
15	9.5	16.5
16	10	17.5
17	11	19
18	12	20

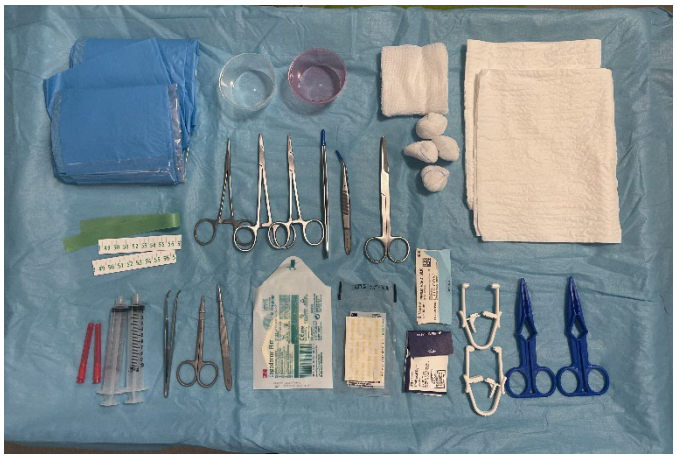
A high UAC position is associated with significantly less risks of clinical vascular compromise and aortic thrombus formation. This position should be used exclusively unless a low position is the only position that can be obtained, and a UAC is deemed necessary for optimum patient care.

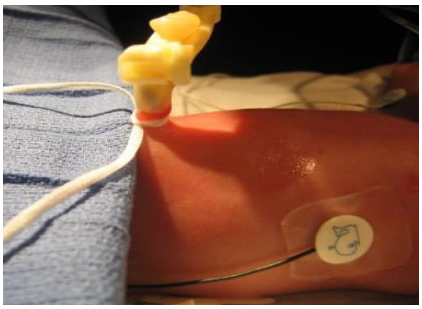
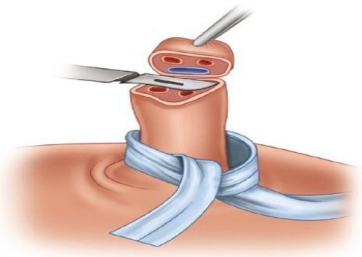
Equipment

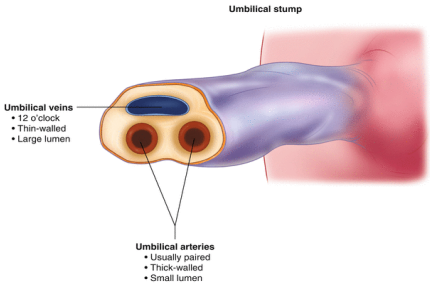
Common equipment	UAC/UVC specific

• Surgical gown x 1
• Sterile pair of gloves x 2
Mask x1
Surgical hat x1
Face Shield (as required) x1
• Antiseptic solution:
  ○ >27 weeks gestation: 1% chlorhexidine solution;
  ○ ≤27 weeks gestation: Povidone-iodine 10% solution/swab
Umbilical line placement kit
• Sterile 0.9% Sodium chloride ampoules x2
• Blunt drawing up needle x 1
• Sterile absorbent towel x 1
3-way tap x1
Bin (consider small easily accessible paper bag)
	• Appropriate size UAC for gestation
	• Fluids
	  ○ ≤27 weeks - Sodium Chloride 0.45% + 0.5 u/mL Heparin
	  ○ >27 weeks - Sodium Chloride 0.9% + 0.5 u/mL Heparin
	• Transducer Set
	• Suture- 3.0 Prolene / 3.0 Silk
	• Sterile Instrument pack
	• Cord tie

Procedure

Steps	Additional Information
1. Open all equipment onto a sterile drape that fully covers the trolley then arrange the equipment in a systematic manner. Ensure three-way tap is connected at end lumen of catheter (this is below)	
2. Draw up 10 mL of 0.9% sodium chloride into a syringe and attach a three-way tap to the catheter. Flush through both the three-way tap and the catheter with the saline (both lumens of the catheter) ensuring that there is no air in the catheter. Leave syringe attached to end of catheter in order to maintain a closed system and be able to aspirate to check for placement.	 **Note: Sodium Chloride for priming of catheters is to be drawn up directly from ampule with a drawing up needle.**
3. Position the infant comfortably and drape the bed with a sterile “blue cloth” on the side where the operator is standing	

4. Hold the cord clamp with the sterile forceps and hand that over to the assistant.	
5. Clean cord and peri-umbilical area with disinfectant appropriate for the age and gestation **Allow to dry for as per CAHS Neonatal asepsis guideline**	Avoid excess application and any spillage around down to the back of the baby as this may cause burns to very preterm skin.
6. Wash off iodine in infants ≤27 weeks with sterile water and pat dry (For other infants wash off at end of procedure)	Prevent potential chemical burns and skin irritation
7. 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.	
8. Make a clean horizontal cut in the cord under the clamp with a scalpel blade (or scissors) preferably leaving 1cm of cord above the skin junction	 Adapted from: Swan T.B. (2018) Neonatal Delivery and the Acutely Ill Neonate. In: Zeretzke-Bien C., Swan T., Allen B. (eds) Quick Hits for Pediatric Emergency Medicine. Springer, Cham. https://doi.org/10.1007/978-3-319-93830-1_6

9. Cover the baby with the large clear plastic drape, with the pre-cut hole in the centre of the drape over the site of insertion. Ensure the sterile field covers the whole bed and extends over the sides while allowing a self-ventilating patient to breathe.	
10. Identify the umbilical vessels: **Vein:** single, large, thin-walled **Artery**: two, smaller, thick wall, generally constricted so that the lumen may appear pin-point.	 Adapted from: Lucas J.K. (2016) Umbilical Venous Catheters (Insertion and Removal). In: Ganti L. (eds) Atlas of Emergency Medicine Procedures. Springer, New York, NY. https://doi.org/10.1007/978-1-4939-2507-0_121
11. The cord stump should be stabilised with artery forceps.	
12. To insert the UAC, stabilise the umbilical cord and if needed gently open it using either the iris forceps (image) (use both tips and gently open to dilate – do not use a single tip of iris forceps as a probe as it is sharp and often causes a false passage) or fine probe. Gradually dilate the artery.	 Repeat probing or excessive pressure must be avoided to prevent pushing the catheter outside the vessel lumen causing a false passage.
13. Cannulate the artery and gently advance the catheter. Obstruction may be encountered at the anterior abdominal wall. Gentle steady pressure with slight rotation may help overcome this. 14. Turn the three-way tap so that the catheter is open to the	

syringe and assess smooth back flow of blood	
15. If there is good backflow, continue inserting to the predetermined length and aspirate to verify blood return.	• Umbilical arteries descend first before looping upward; therefore, the catheter should be passed upwards • At no stage excessive force or pressure should be applied • All lines (venous and arterial) should be able to be bleed back on insertion; and should not be used if they do not.
16. If unsuccessful, ask for help. Only attempt one of the arteries, so that there is one untouched vessel retained for the next person to attempt. *Never use a blade or scissors to trim the umbilical cord while any umbilical catheter (venous or arterial) is in place*	For UACs, the most common error arises after cannulating the layer between the vascular intima and the muscle and forming a "false passage". This usually occurs if dilatation of the artery in the cord has been inadequate.
17. Secure the catheter with an anchoring suture that is close to the catheter and goes through Wharton's jelly and **taking a small bite through the skin**. Anchor the knot close to the catheter. **UAC and UVC should ALWAYS be sutured separately.**	Tie the suture around the UAC tight enough to prevent slippage but still allowing easy drawback and flushing of the line.
18. Open the transducer with infusion giving set onto sterile field. Assistant to attach to syringe for priming. Primed giving set and transducer to be attached to catheter using sterile aseptic technique.	Calibrate transducer and commence infusion at 0.5-1ml/hr **prior to** x-ray confirmation of placement. Check that there is not blood bleeding back into line and if there is gently flush until clear and increase infusion rate. The transducer should always be positioned at the level of the right atrium.

19. Apply a 2.5cm piece of brown tape around catheter and suture material as close as possible to umbilical stump/catheter. Alternatively, apply sterile umbilical catheter dressing.	If using brown tape, UAC & UVC should be secured separately.
20. Remove excess skin prep with sterile water or saline.	Residual cleaning solutions on the infant's skin can be a potential for chemical skin burns.
21. Clear away all equipment and ensure that any needles or scalpel are safely disposed of into a sharps bin.	To safely dispose the sharps, post procedure
22. Check the infant is left clean and dry, check linen under the infant and assess temperature	
23. **Complete the Neonatal Intravascular Device Insertion Record (MR422) and document in medical records**	
24. Infant to be nursed supine for a minimum of 1 hour post insertion to observe for ooze/blood loss around umbilical stump.	
26. Xray to confirm tip placement	

Post Procedure Management:

1. Confirm the catheter tip placement with an X-ray:
   - Refer to Central Line Imaging in Neonates: Radiographic Views, and Acceptable Line Positions

UAC Optimal position	T6- T9
Acceptable position with caution	L3-L4 (low UAC)

Not acceptable position	T12- L2 (as mesenteric arteries and renal arteries arise) or any diversion into the lower limbs.

2. A repeat x-ray is to be performed following catheter adjustment to confirm tip position. Adjustments to be documented in medical notes.
3. Clinician performed ultrasound may be used in conjunction with X-ray to ensure safe placement and adjustment of UAC.

Nursing Management

- Infants with umbilical lines in situ should not be wrapped or have booties on and nappy is to be left loose, allowing pelvic area and feet to be visible to check for adequate circulation.
- At least hourly inspection of umbilical site for any signs of infection, ooze and catheter position (distance of brown tape from umbilical stump). Document on MR489.
- At least hourly inspection of colour, temperature and perfusion of the lower extremities. Any changes should be reported immediately to medical staff.

Arterial Transducer

- The arterial transducer provides continuous blood pressure monitoring
- The transducer should always be positioned at the level of the right atrium (horizontal to) for accurate monitoring and should be free from blood
- NOTE: non-invasive cuff BPs may provide a +/- 10mmHg discrepancy compared to the arterial transducer. If the arterial transducer has a good trace and in the optimal position, this should be considered the more accurate reading.
- The UAC can be used to for blood sampling which eliminates the need for heel picks and venepunctures. This is an aseptic technique which can be conducted by nursing staff members who have been trained in the procedure. Refer to Appendix 4 for procedure on sampling from the UAC.

UAC Removal

- Review the need for the UAC on clinical rounds every day. Consider removal within 5 days of insertion.
- Removal of an umbilical catheter is a **2-person** aseptic technique, where staff have received training and deemed competent.

- Once the catheter has been removed, complete the Neonatal Intravascular Device Insertion Record (MR422) and document in medical records.
- Refer to Appendix 5 for Removal of UAC procedure

Related CAHS internal policies, procedures and guidelines

Central Line Imaging in Neonates: Radiographic Views, and Acceptable Line Positions

Central Venous Access Device Bundle

Hand hygiene

Sepsis Neonatal

PCH Central Venous Access Devices (CVAD) and Midline Insertion and Management

References and related external legislation, policies, and guidelines

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This document can be made available in alternative formats on request.

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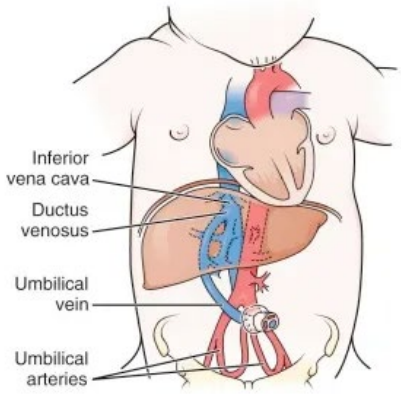
Appendix 1: Anatomy and Position

The umbilical arteries are the direct continuation of the internal iliac arteries. A catheter passed into an umbilical artery will usually (but not always) enter the aorta via the internal iliac artery. Its path is, therefore, initially inferior and lateral as it passes around the bladder, before turning cephalad and medial to enter the aorta.

Occasionally it may pass into the femoral artery via the external iliac artery or into the gluteal arteries. The femoral artery or gluteal artery are unsuitable sites for sampling, infusion, or blood pressure monitoring.



Adapted from: *From Robert and Hedge's Clinical Procedures in Emergency Medicine*

There are two potential positions for the UAC. These are described as "high" or "low".

- The high position is at the level of thoracic vertebral bodies T6-T9. This position is above the coeliac axis (T12), the superior mesenteric artery (T12-L1), and the renal arteries (L1). This position is essentially "above the diaphragm".
- The low position is at the level of lumbar vertebral bodies L3-L4. This position is below the structures as above and is above the aortic bifurcation (L4-L5). The inferior mesenteric artery arises from L3-L4. This position is essentially "above the bifurcation".

A high UAC position is associated with significantly less risks of clinical vascular compromise and aortic thrombus formation. This position should be used exclusively unless a low position is the only position that can be obtained, and a UAC is deemed necessary for optimum patient care.

Appendix 2: Umbilical Placement Kit

- 1 x outer wrap
- 2 x drape towels (absorbent/impermeable)
- 2 x blue prep forceps
- 2 x measuring tapes (60cm)
- 2 x Tegaderm dressings (4cm x 4cm)
- 1 x 10ml luer lock syringe
- 1 x silicone neonatal tourniquet
- 4 x ball swabs
- 2 x hand towels
- 1 x peelable transparent drape with ‘easy peel’ 50cm x 50cm (opening 4cm)
- 1 x straight Reynolds scissors 9cm
- 1 x straight Iris forceps 10cm
- 1 x curved Iris forceps10cm
- 5 x swabs, 4 ply (7.5cm x 7.5cm)
- 2 x gallipots 60ml
- •1 x tray 20cm x 15cm x 4xm
- 1 x pack of small steri-strips (6 x 38mm, x 6)

- **Note:** PICC placement kit is preferred, in-line with the PCH CVAD guideline. However, suitable sterile reusable instrument kits may be used when PICC kits are not available.

Appendix 3: Alternative method for UAC insertion:

For difficult arterial insertion especially in cases of absent insufficient or Wharton's jelly to support the umbilical cord, suture method may be used.

A 4-0 or 5-0 silk suture needle is inserted directly into the arterial lumen and out of 1 arterial sidewall approximately 3-4 mm below the opening of the lumen. Once outside of the arterial wall, the needle is driven through Wharton jelly back to the surface of the transected stump. Gentle, upward traction is applied to the suture, which opens and stabilizes the lumen of the artery

Placement of suture through the arterial wall allows for true upward traction and complete control over the position of the lumen, which is difficult to achieve with iris forceps alone

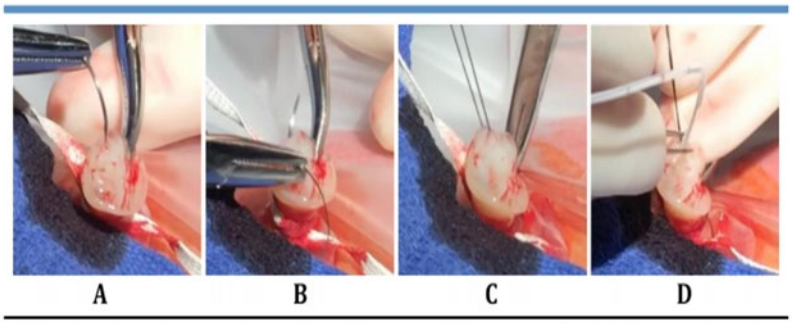


Figure. Technique for UAC placement: **A,** insert suture needle directly into arterial lumen; **B,** drive needle through arterial sidewall and Wharton jelly; **C,** apply gentle upward traction to suture; and **D,** insert umbilical catheter.

Please refer to the link below for more detailed description of the method and access to the instructional video

J Pediatr 2015;166:501. http://dx.doi.org/10.1016/j.jpeds.2014.10.027

Appendix 4: Blood Sampling from the UAC

Key Points

- All blood sampling via umbilical catheters is to be ordered by medical staff.
- Where possible blood glucose sampling should coincide with ordered tests to reduce frequency of accessing the line.
- If an arterial line is not insitu the UVC can be used for sampling. Note that blood glucose levels may not be as accurate due to the glucose in infusions.
- Sampling from umbilical lines can be performed by staff deemed competent in the procedure.
- There is potential risk of infection, vasospasm, emboli and ischaemic injury associated with this procedure.

Equipment

- Blue Tray
- 2% Chlorhexidine/Alcohol swab
- Sterile gauze
- Red combi stop
- 2mL syringes (2-3)
- Blood gas syringe
- Sodium Chloride 0.9%
- Blood specimen tubes

Procedure

Steps	Additional Information
1. Perform hand hygiene, clean blue tray and prepare equipment	Aseptic Technique/ Infection Prevention Open syringe packaging – leave in sleeves to protect key parts, prepare flush, open gauze pack and chlorhexidine swab
2. Put infusion pump on hold	
3. Perform hand hygiene and don gloves	Aseptic Technique / Infection Prevention
4. Use sterile gauze to hold 3way tap, turn 3way tap off half way between ports and remove combi stop.	
5. Clean the exposed port with a Chlorhexidine Swab for 30 seconds. 6. Allow to dry.	Reduces the risk of infection.
7. Attach empty 2mL syringe turn 3way tap open to syringe and slowly withdraw 1mL of blood. Turn 3way tap off halfway between ports	

Steps	Additional Information
8. Remove syringe and re-sleeve	This blood is to be returned to the infant.
9. Attach gas syringe and slowly withdraw required sample volume. Turn 3way tap off halfway between ports remove syringe and re-sleeve.	
10. Take further samples as required. Ensure three-way tap is off halfway between ports when attaching and removing syringes.	
11. Slowly Return blood taken initially back to infant. Withdraw the plunger slightly after connecting to the 3way tap ~~Take care~~ to remove air bubble from dead space in 3way tap before returning blood.	
12. Take care to remove air bubble from dead space in three- way tap before flushing Flush three-way tap and catheter with 0.9% Sodium Chloride using a pulsatile motion (push-pause).	This takes approximately 0.5mL.
13. Clean 3way with 2% Chlorohexidine swab and attach new combi stop. Recommence infusions. Zero the transducer.	
14. Perform hand hygiene.	
15. Document blood volume taken, blood tests and flush volume.	

Appendix 5: Removal of UAC (2 person procedure)

Equipment required

- Mosquito Forceps Straight and Iris Scissors Straight
- >27weeks gestation 1% Chlorhexidine solution
- ≤27weeks gestation or Povidone Iodine 10% swab
- Dressing pack
- Gloves (sterile gloves not required)
- Sterile non-woven (soft) Gauze
- 0.9 % Sodium Chloride

Procedure steps

Pre-procedure - Perform the **Removal Procedure Safety Checklist including Time Out** as per the Umbilical Arterial and Venous Catheter (UAC/UVC) Insertion and Removal MR 422.00

1. Perform hand hygiene and prepare equipment using aseptic technique.
2. Assistant to gently hold the legs of the infant. Consider sucrose as pain relief
3. Perform hand hygiene and don gloves
4. Remove the tape around the catheter to be removed if suture not visible. If coagulated blood around suture material and umbilical stump, moisten gauze with sodium chloride and wrap around umbilical stump for 1-2minutes. Clean area prior to commencing procedure.
5. Examine umbilicus to confirm UAC and UVC are sutured separately. NOTE: some referral centres may secure both UAC and UVC together using a single suture technique.

TIME OUT: Before applying the forceps to the umbilical catheter to be removed, the assistant must visualise the forceps and agree that it is a forceps and not a scissor.

6. Apply artery forceps **below the sutures** prior to cutting the suture (to prevent migration of the catheter internally in the advent of the catheter being accidentally cut).

   Then cut the suture.

7. Place gauze pad directly over the umbilicus, apply gentle pressure in downward direction for a UAC.
8. Remove catheter in a slow continuous motion to promote vasoconstriction. Check that catheter is intact. Continuous pressure should be applied for a minimum of 5 minutes. Ensure the peripheries stay pink and well perfused.
9. Clean skin prep from skin with sodium chloride and leave infant in the supine position with the stump uncovered for one hour to observe for any blood loss. Perform hand hygiene post procedure.
10. Document the removal procedure on Neonatal Intravascular Insertion Record MR422, and in the patient's progress notes. Include estimated blood loss (if any)