

ARTERIAL CATHETER MANAGEMENT IN NEONATES - GCNC - CHW

PRACTICE GUIDELINE[®]

DOCUMENT SUMMARY/KEY POINTS

- A guideline for clinicians in the Grace Centre for Newborn Intensive Care on inserting peripheral and umbilical arterial catheters, their management, sampling and removal
- Invasive arterial monitoring is indicated when you are considering treating hypotension, post operatively, or where frequent (ie less than 8 hourly) blood sampling is required
- Arterial lines are inserted by a nurse practitioner or medical officer
- Patency is maintained with heparinised saline infusion. No other substance should be infused or injected. The transducer needs to be calibrated 8/24, after line change, and at the beginning of each shift using a spirit level
- The fluid in the line needs to be contiguous with no air present
- Arterial blood sampling is performed by accredited staff only
- Distal perfusion should be checked and documented hourly whilst the line is in situ
- Insertion site needs to be observed for 4 hours post removal of an arterial line

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

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| Approved by: | SCHN Policy, Procedure and Guideline Committee | |
| Date Effective: | 1st November 2023 | Review Period: 3 years |
| Team Leader: | Clinical Nurse Consultant | Area/Dept: GCNC CHW |

CHANGE SUMMARY

- Content has been rearranged for more logical flow and ease of understanding
- Reference table of upper limit targets for blood pressure has been added
- Guidelines for UAC insertion have been consolidated into the document
- Complications of arterial lines have been consolidated into a single table
- Referencing has been updated

READ ACKNOWLEDGEMENT

- Medical and nursing staff receives education and supervision in the management of arterial lines
- Nursing staff are required to complete a biannual accreditation and eLearning program
- Clinical staff caring for neonates with arterial lines should read and acknowledge this document

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

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Management of arterial lines

Defining Statement

Invasive blood pressure measurement provides beat to beat assessment of the heart rate and blood pressure^{1,2}. In infants with normal blood pressure non-invasive blood pressure measurement is considered an accurate means of measurement. For infants with fluctuating blood pressure (hypo or hypertension) or when delivering inotropic medication intra-arterial monitoring is more accurate and recommended to support clinical management. Additionally indwelling arterial lines allow painless and free flowing blood sampling for infants.

Terminology

Systolic Blood pressure

Systolic pressure represents the peak pressure in the arteries during systole. Changes in the stroke volume can be reflected in the systolic pressure¹.

Diastolic Pressure

Diastolic pressure is the sustained pressure within the cannulated artery when the heart is relaxed allowing filling in diastole. It is a combination of the pressure exerted by the blood flow within the artery and the vascular compliance of the arterial wall. In the newborn the heart rate influences diastolic ventricular filling time and the bradycardic or 'diving' reflex actually initially increases the blood pressure¹.

Mean arterial Pressure (MAP)

The mean arterial pressure is calculated by the following:

$$\text{MAP} = [(2 \times \text{diastolic}) + \text{systolic}] / 3$$

Hypotension

In neonatology the MAP is used as a guide to the overall perfusion of the infant. Mean BP is calculated using the 10th centile in the first 24 hours according to birth weight:

| Birth Weight | 10th centile for MAP ³ |
|-----------------|-----------------------------------|
| 500-750 grams | 26 mmHg |
| 750-1000 grams | 28 mmHg |
| 1000-1250 grams | 29 mmHg |
| 1250-1500 grams | 30 mmHg |

From these calculations it can be derived that MAP should be maintained above the gestation in weeks during the first few days of life. There is some evidence that babies who mean arterial pressure is ≥ 33 mmHg have better developmental outcome and less brain injury⁴.

Hypertension

Upper limits for neonatal blood pressure are more difficult to define, especially for neonates in Grace who often have complicated cardiac anatomy. The following table has been adapted from limited available data⁵ for neonatal blood pressure after the first two weeks of life and may act as a guide for identifying when to initiate cardiology review and/or treatment for hypertension in our patients.

Infants that persistently maintain blood pressure above the 95th centile are considered hypertensive, and those with blood pressure above the 99th centile should be referred to cardiology for review and possible treatment.

| Gestational age | 50th percentile | 95th percentile | 99th percentile |
|-----------------|-----------------|-----------------|-----------------|
| 26 weeks | 55/30 (38) | 72/50 (57) | 77/53 (63) |
| 28 weeks | 60/38 (45) | 75/50 (58) | 80/54 (63) |
| 30 weeks | 65/40 (48) | 80/55 (65) | 85/60 (68) |
| 32 weeks | 68/40 (48) | 83/55 (62) | 88/60 (69) |
| 34 weeks | 70/40 (50) | 85/55 (65) | 90/60 (70) |
| 36 weeks | 72/50 (60) | 87/65 (72) | 92/70 (71) |
| 38 weeks | 77/50 (60) | 92/65 (75) | 100/70 (80) |
| 40 weeks | 80/50 (60) | 95/65 (75) | 100/70 (80) |
| 42 weeks | 85/50 (62) | 98/65 (76) | 102/70 (81) |
| 44 weeks | 88/50 (63) | 105/68 (80) | 110/73 (85) |

Pulse Pressure

Pulse pressure is the difference between systolic and diastolic pressure. It is a reflection of the filling or intravascular volume during diastole. A widened pulse pressure is seen where there is run off into the pulmonary circulation via a widely patent ductus arteriosus or where there is inadequate filling in hypovolemia or sepsis. A narrow pulse pressure may indicate a failing line or reflect increased vascular resistance.

Phlebostatic axis

The phlebostatic axis provides an external reference point that approximates the anatomic level of the left and right atria and the pulmonary artery.

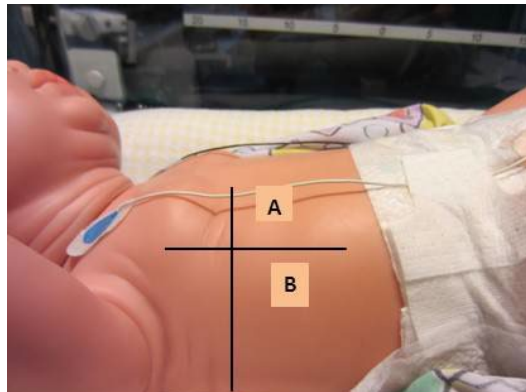


Figure 1. Phlebostatic axis

For a newborn in the supine position, locate the insertion of two imaginary lines, one drawn from the fourth intercostal space at the sternum toward the axilla and one drawn horizontally down the anterior axillary line. An imaginary vertical line from the fourth intercostal space at the sternal border to the right side of the chest (A)

A second imaginary line is drawn horizontally at the level of the midpoint between the anterior and posterior surfaces of the chest (B). The phlebostatic axis is located at the intersection of points A and B.

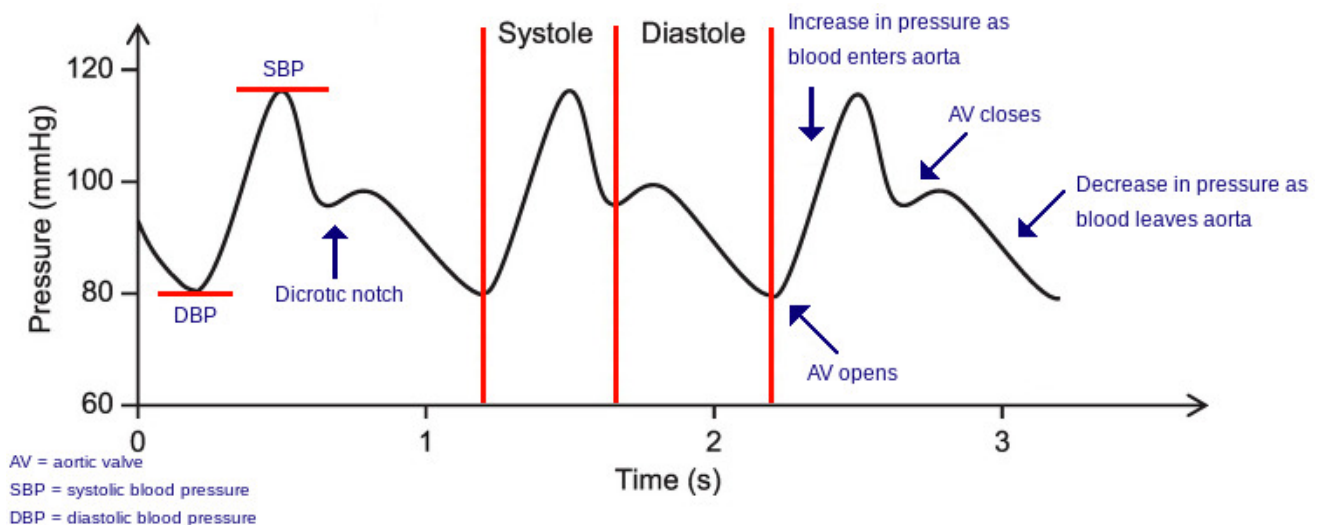


Figure 2. Normal arterial line waveforms in Neonates

Technique for calibrating “zeroing” the system

The arterial monitoring transducer must be zeroed on insertion, once per shift and if there is major position change of the infant in relation to transducer.

The right atrium is used as a reference point for arterial and central venous pressure measurements. The position of the right atrium is estimated at the phlebostatic axis. The site of the phlebostatic axis is at the intersection of the fourth intercostal space and mid axillary line.

“Zeroing” is the method of calibrating the system to atmospheric and hydrostatic pressure.

- The transducer is levelled with the phlebostatic axis
- The stopcock on the transducer is opened to air and the cap removed
- Zero is pressed on the module
- Once the module indicates that zeroing has occurred the cap can be replaced on the transducer and the stopcock closest to the infant can be repositioned to neutral position

Educational notes

- The umbilical vessels allow easy central vascular access to the newborn infant in need of intensive care therapy.
- Babies who are born critically unwell and in need of inotropic or nutritional support have an umbilical venous catheter (UVC) inserted on Day 1.
- An umbilical arterial catheter (UAC) is also indicated for babies with significant critical illness who is likely to require inotropy or frequent sampling of blood.
- Typically, UAC are single lumen whereas a multi-lumen UVC is used.

Relative Contradictions

- Omphalitis
- Omphalocele
- Pre-operative patients with transposition of the great arteries unless no other access can be established

Peripheral artery cannulation

Preferred sites

In the newborn, the radial, ulnar, dorsalis pedis and posterior tibial sites are preferred over the brachial, femoral or axillary sites of insertion⁶. Brachial or femoral arteries are avoided where possible as these are prone to thrombosis and may not have adequate collateral circulation to compensate. In the critically ill patient however brachial or femoral access may be necessary at the discretion of the Neonatologist or an Anaesthetist Femoral arterial access is unwise under baby weight of 2kg as they are highly prone to thrombosis.

Patient Safety

An artery with collateral circulation should only be cannulated. An Allen test should be performed when the line is planned for the radial or ulna artery to ensure adequate collateral perfusion of the hand.

Allen's test

Steps:

1. A neonate cannot voluntarily clench and release their fist as what would typically be required for this test, so close their hand tightly for them.
2. Elevate the arm and simultaneously occlude the radial and ulnar arteries at the wrist, then rub the palm to cause blanching.
3. Release the pressure on the ulnar artery (see image below):
 - i. If normal colour returns to the palm in < 10 seconds, adequate ulnar circulation is present signalling good blood flow (positive test)
 - ii. If normal colour doesn't return within 10 seconds, ulnar circulation is inadequate/non-existent (negative test)

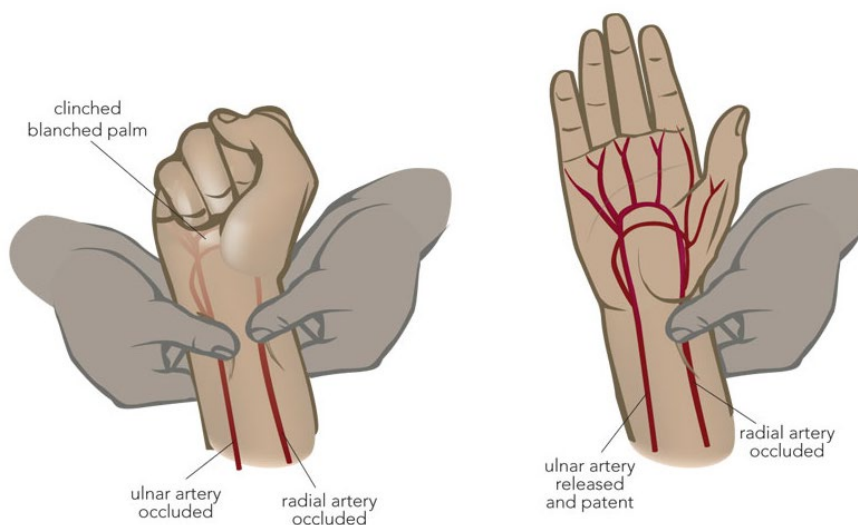


Figure 3. Allen's test Image courtesy of:
(<https://www.safercare.vic.gov.au/sites/default/files/inline-images/Allens-test-fig1.jpg>)

- Arterial cannula should not be inserted in sites where there may be vascular compromise or thrombosis.
- 0.1% aqueous chlorhexidine is the preferred solution for skin preparation prior to insertion.
- The arterial line set-up must be connected to the cannula with extension tubing that includes a needle free valve (preferably red). This ensures;
 - The safety of a double Luer lock
 - Ease of identification that the catheter is arterial rather than venous
- Label the line with a sticker stating that it is Arterial.
- When priming the arterial line ensure that all air is removed from the system as the smallest amount of air can distort waveforms and arterial pressure readings².

Developmental and family support

- When placing invasive lines explain the purpose and procedure to the parent/carer(s).
- Administer sucrose or expressed breast milk to the infant prior to the [procedure](#).
- Ensure the limbs are supported to prevent damage to joints and underlying nerves.
- Provide containment and support to the infant during the procedure

Technique

The allocated patient nurse assists the medical officer or nurse practitioner with the insertion of the arterial cannula. This assistance not only involves the actual technical aspects of cannula insertion but ensures the infant is positioned appropriately, contained and supported.

Prepare the arterial line giving set prior to cannulation to ensure efficiency of attachment and line maintenance post insertion. The infusion solution is ordered on the fluid chart by the medical officer and checked by two registered nurses, or a doctor and a registered nurse.

Equipment required for setting up system

- Pressure module and transducer
- Transducer holder
- 3ml transducer kit
- Pre-packed heparinised saline syringe 50IU/50ml
- Label for infusing fluid

Equipment for cannula insertion

- 24 gauge cannula (unless other gauge specified)
- Sterile gloves
- Procedure trolley
- Dressing pack
- 0.1% aqueous chlorhexidine solution
- 0.9% sodium chloride vial
- 50IU/5ml heparinised saline vial
- Extension set with needle free valve (preferably red)
- 18G blunt needle
- 5ml luer lock syringe
- Goggles
- Sorbaview dressing for securing cannula
- Appropriately sized arm board
- Spring guide wire if required
- Vascular illuminator visualising the artery to be cannulated

Insertion Technique

1. Parental consent is obtained prior to commencing the procedure.
2. Clean procedure trolley
3. Remove bedding/nest/ clothing that will obstruct access to peripheral limb
4. Perform hand hygiene and apply sterile gloves
5. Set up equipment on procedure trolley

6. Draw up syringe consisting of 1ml (5IU) of Heparinised Saline + 4ml of 0.9% sodium chloride to make 5mL syringes of 1IU/ml Heparinised Saline
7. Connect IAL needleless access device extension piece and prime it
8. Clean prospective IAL insertion site with chlorhexidine
9. Puncture the artery using the 24G cannula at an angle of 30–45 degrees and insert slowly until flashback of blood is visible in the stylet of the cannula
10. Withdraw the stylet while advancing the catheter slowly
11. Connect and flush with syringe of 1IU/mL heparinised saline and observes for blanching proximal to the insertion site
12. Secure the cannula with taping and splint
13. Connects IAL extension piece to transducer set
14. Observes distal limb perfusion post-procedure
15. Level and zero the transducer
16. Dispose of all sharps in sharps bin
17. Document insertion in eMR

Securing the Arterial Cannula



Figure 4. Securement of peripheral IAL using occlusive dressing

The arterial cannula must be securely strapped. First preference is to use an occlusive window dressing such as a Sorbaview dressing.

The limb may be supported by an arm board that is placed on the back of the arm and taped securely in place allowing slight extension of the wrist. Skin area at cannula tip should be visible.



An alternative method is to place two 1cm wide tapes underneath the cannula and cross them over the top. A further piece of tape is placed lengthways across the cannula hub. This method should only be utilised if a Sorbaview is not possible (i.e., due to positioning of the line or size of the patient).

Figure 5. Securement of peripheral IAL using tapes

Umbilical artery catheterisation

Umbilical artery catheterisation is a skill undertaken by trained medical officers and nurse practitioners. The bulk of the equipment required for this procedure can be found in specifically designed umbilical insertion packs. Umbilical arterial lines can be successfully placed throughout the neonatal period but are most commonly used in the first week of life.

Equipment required for setting up system

- Pressure module and transducer
- Transducer holder
- Pre-packed heparinised saline syringe 50IU/50ml
- 3ml transducer kit
- Label for infusing fluid

Equipment for cannula insertion

- Sterile gloves
- CVAD Procedure trolley
- 4.0 silk suture
- Scalpel blade
- Single lumen UAC (3.5Fr, 5Fr)
- Sterile gown
- 2x sterile gloves
- Hair net
- Sterile linen cord tie
- Sterile gauze swabs
- 2x 10ml luer-lock syringes
- 2x vials 0.9% sodium chloride vials
- 2x vial 50IU/50ml heparinised saline
- 2x sterile drape
- Mask
- Goggles
- 0.1% aqueous chlorhexidine solution
- 0.9% sodium chloride vial
- 50IU/5ml heparinised saline vial
- Red - Extension set with needle free valve
- 18G blunt needle
- 5ml luer lock syringe

Insertion Technique

1. Advise parents of need for procedure and the process
2. Measure and record predicted depth of insertion based on graph – see below

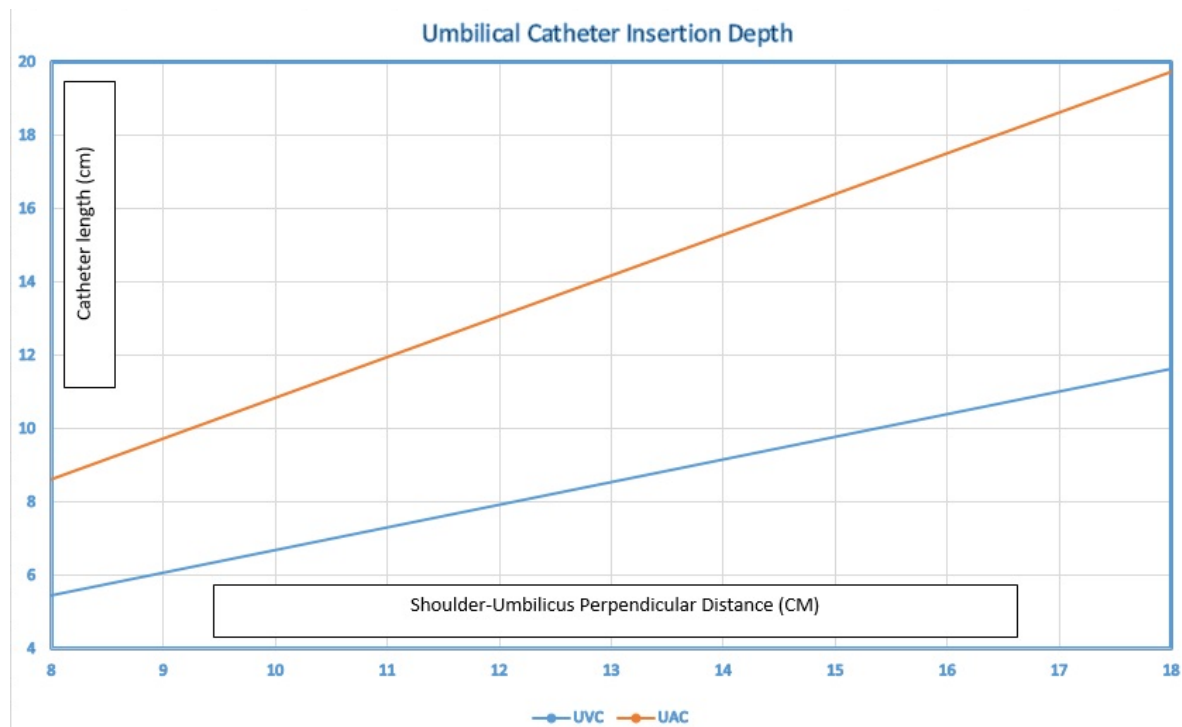


Figure 6. The distance to insert an umbilical artery catheter for it to be sited above the diaphragm and an umbilical venous catheter for it to be at the IVC-RA junction. Adapted from Dunn, P.M. Arch Dis Child 1966; 41: 69.

3. When inserting UVC along with UAC always insert UAC first as UVC is prone to falling out and is more easily placed than UAC; Once arterial line is in situ, the artery holds it snugly in place as it will usually spasm around it holding the line more firmly than the vein will. Secondly the arterial lines are more difficult and often require a second cutdown of the stump which is precluded if venous line already in situ.
4. Clean procedure trolley
5. Remove bedding/nest/clothing/nappy that will obstruct access to umbilical area
6. Mask, goggles and hairnet should be donned prior to scrubbing
7. Set up equipment on CVAD/UAC procedure trolley using ANTT
8. Set up gown and gloves using ANTT
9. Surgical hand-wash and then don gown and glove
10. Draw up 2 syringes consisting of 2ml (10IU) of Heparinised Saline + 8ml of 0.9% sodium chloride to make 10ml syringes of 1IU/ml Heparinised Saline
11. Connect IAL needleless access device extension piece and prime lumen of UAC
12. Sterilise the cord and surrounding area with 0.1% aqueous chlorhexidine and allow it to dry for 3 minutes

13. Drape umbilicus and abdomen with fenestrated sterile drape
14. Remove first set of sterile gloves using ANTT
15. Apply sterile cord tie to the base of the cord
16. Use scalpel to cut cord between cord clamp and umbilical base
17. Identify umbilical arteries and umbilical vein
18. Dilate umbilical artery with lacrimal probe and/or fine-toothed forceps
19. Insert arterial catheter with forceps to recorded depth
20. Confirm blood withdrawal – should be bright red in oxygenated baby
21. In cyanosed baby may need a blood gas analysis to confirm arterial
22. Secure catheter by suturing to the Wharton's Jelly and more robustly with goalpost dressing – see pictures
23. Connect UAC to transducer set – see trace to confirm arterial placement
24. Confirm position of UAC with Xray
25. Complete CVAD insertion documentation (if UVC is also inserted at this time) and document UAC insertion in eMR. Include type/size/length of catheter inserted in centimetres, the position of catheter tip on x-ray in relation to landmarks, and the colour, perfusion and warmth of lower limbs and buttocks.

Trouble shooting complications associated with UAC insertion

| | |
|---|--|
| Resistance before tip reaches abdominal wall (less than 3cm from surface of abdominal stump). | <ul style="list-style-type: none"> • Loosen umbilical tie • Refine dilation of artery |
| "Popping" sensation rather than "relaxation" | <ul style="list-style-type: none"> • Catheter may have exited lumen and created false channel • Remove and use second artery. Observe for intra-abdominal haemorrhage |
| Backflow of blood, particularly around vessel | <ul style="list-style-type: none"> • Tighten umbilical tape • Catheter may be in false channel with extravascular bleeding • Remove and use second artery |
| Resistance encountered at anterior abdominal wall or sharp turn in vessel as it angles around bladder toward internal iliac artery (approximately 6-8cm from surface of umbilical stump in 2- 4kg neonate). | <ul style="list-style-type: none"> • Apply gentle but steady pressure for 30-60 seconds • Position infant on side with same side elevated as artery being catheterized. Flex hip |

| | |
|-------------------------------------|--|
| Easy insertion, but no blood return | <ul style="list-style-type: none"> • Catheter is likely outside vessel and in a false channel • Remove and observe infant carefully for evidence of complications/internal haemorrhage |
|-------------------------------------|--|

Securing the UAC

This component often occurs in combination with the UVC:

- A purse-string suture (4.0 silk suture) is inserted into the umbilical stump (not surrounding skin area) and then looped around catheter to secure line with 3 suture points around the line. Make sure suture loops are not too tight to cause occlusion to catheters
- Suture each line separately to facilitate adjustment of lines post check X-ray
- Apply leucoplast in goal post formation maintaining UVC and UAC separate again to facilitate adjustment post check Xray (see Figures six, seven and eight)
- Two pieces of protective dressing - Coloplast® should be cut and positioned to fit under the leucoplast. The Coloplast® is used to protect the skin and provide a barrier against epidermal stripping should the tape be removed in the first days following birth

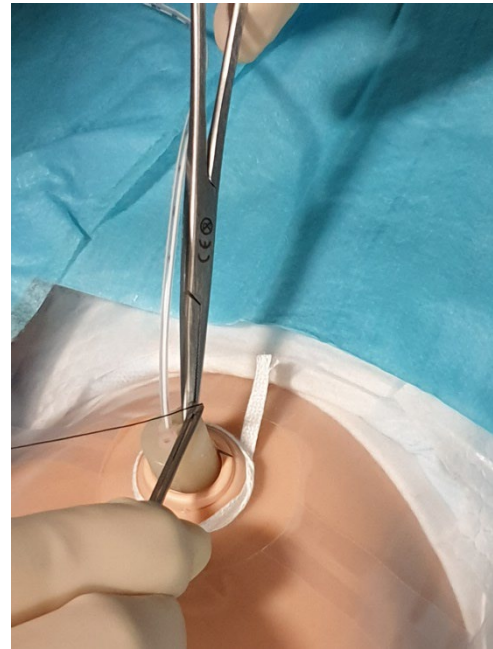


Figure 7. Suturing of UAC

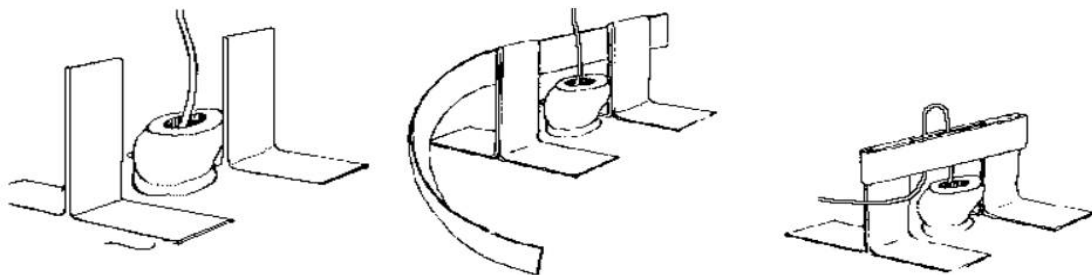


Figure 8. Demonstrates securing method

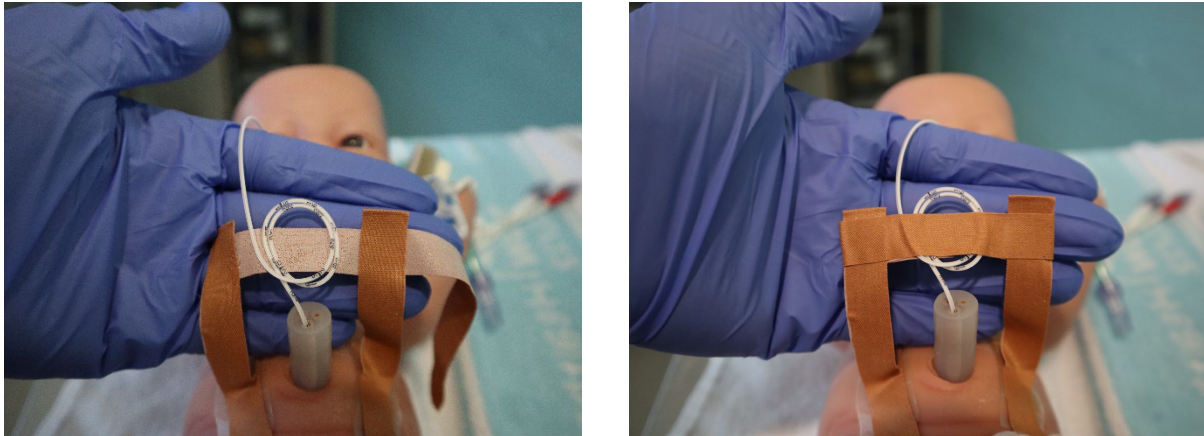


Figure 9. Ensure tape is secure and catheter is looped so that accidental tension to line will not displace catheter

X-ray confirmation of line position

There are two potential tip positions for the UAC. These are described as “high” or “low”.

- The high position is tip “above the diaphragm” at the level of thoracic vertebral bodies T6-T9
- The low position is tip at the level of lumbar vertebral bodies L3-L4. The inferior mesenteric artery (IMA) arises from L3-L4. This position is essentially between the bifurcation and IMA origin. Lying below the major aortic branches. In most infants this position coincides with aortic bifurcation at upper end of the 4th lumbar vertebra

A Cochrane Systematic Review⁷ suggests that a high position is preferred as it is associated with fewer obvious vascular complications, a probable reduction in the incidence of aortic thrombus and longer catheter life. All catheters should be checked radiographically for correct placement prior to use.

- Correctly placed UVC/UAC lines: UAC and UVC should be located on the left and right paramedian respectively
- Ideally, both should be above the diaphragm with the UAC between T6 and T9
- Immediately check colour, perfusion and warmth of buttocks and lower limbs (UAC). Recheck at regular intervals.

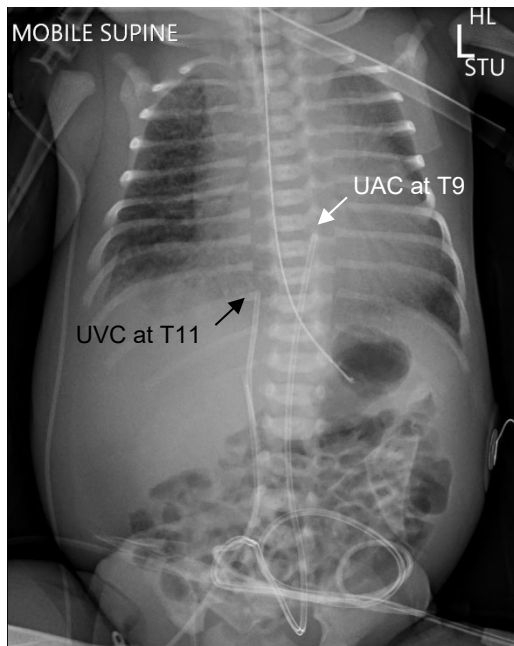


Figure 10. Demonstrating UAC position on x-ray.

UAC insertion care

- Unless the sterile field has been maintained you should not advance catheters following x-ray as this may introduce infection and potentially contaminate a line. In this instance the line should be removed and a new line placed
- Do not leave catheter open to atmosphere due to the danger of air embolus.
- If removing the catheter for any reason, do so slowly over several minutes to allow spasm to assist and control haemorrhage
- Attach infusion as soon as possible to reduce risk of blockage
Caveat: infusions may be commenced after confirmation via x-ray in order to maintain sterile field, especially if UVC is being inserted at the same time. In this case, 10ml syringes may remain connected and should be flushed in a pulsatile manner intermittently until position is confirmed and infusions commenced
- There may be more bleeding from the umbilical vein than the artery as it is not a contractile vessel. If bleeding persists tighten the cotton tape slightly around stump ensuring not to occlude lines
- If the site continues to ooze wrap Hemostat® or similar haemostatic agent around stump and consider reviewing the coagulation profile of the infant. When the bleeding is controlled this should be removed

Patient safety specific to management of UAC

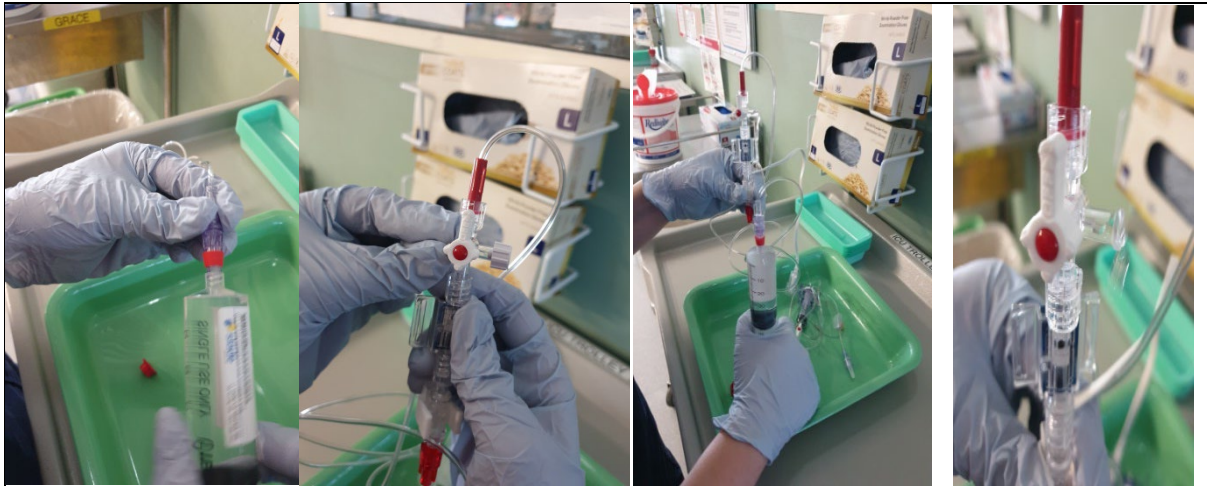
- Carefully label the arterial catheter, the associated tubing and infusion pump to avoid inadvertent administration of vasoactive substances or medication through the artery
- Inspect the integrity of the catheter and infusion system every hour to avoid accidental haemorrhage⁸

- Check that all connections are tight and secure to prevent air embolus and disconnection
- Verify that the stopcocks are positioned appropriately (off to atmosphere) in particular after the system has been calibrated
- Ensure the infusion pump setting is correct and the pressure alarm is set to alert the nurse of any problems with backflow
- When a UAC is in use, booties are not to be worn, including use of wrappings/blankets which cover legs or feet. The toes, feet and legs are checked for discolouration and signs of blanching every hour. Any discolouration must be documented and reported to the medical officer immediately
- The nappy must be fastened in a manner so as not to obscure the umbilical stump, and to allow easy access to viewing buttocks
- Check security of dressing and the catheter, remembering that with umbilical sloughing the suture securing the catheter will weaken

Priming the Safeset™

1. Attend to hand hygiene.
2. Prepare a clean space with a green tray as per local ANTT principles.
3. Prime the SafeSet giving set using a pre-filled heparinised saline syringes of 50 International Units/5mL concentration as demonstrated below.

Caveat: If this is not available prepare Heparinised saline syringe by adding 50 International Units (IU) of Heparinised Saline (50 International Units/5mL concentration) to 50mL of 0.9% sodium chloride.



Connect the infusion to the bung with the red marking

Turn the transducer 3-way tap to point at the red connection

Squeeze white brackets and purge infusion

Fluid should be dripping out the side port



Remove the white cap and replace with a red cap

Turn the 3-way tap to the red bung

Draw up air into your syringe

Fill syringe chamber by purging the infusion and squeezing white brackets. Hold syringe upright

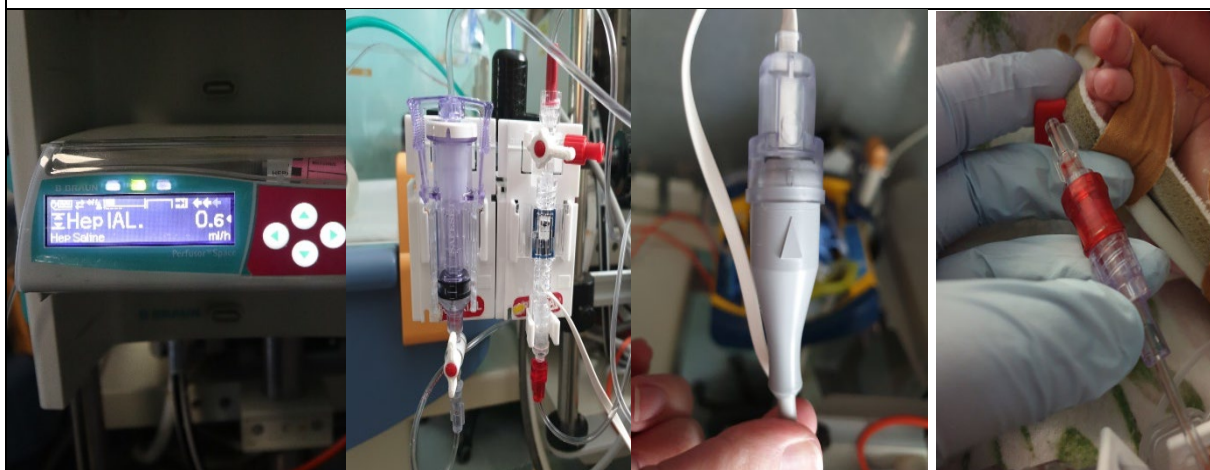


Tap the syringe to move any air bubbles and push the plunger in until you hear a soft click.

If there is insufficient fluid to prime, purge more using the push-squeeze-purge technique

Label the syringe writing 'pre-made' in the additives section and apply ensuring not to obscure the batch number, expiry or contents

Take to the patient bedside with 2 RNs



Put the infusion into a Braun pump and set to HepIAL – this should automatically set rate to 0.6ml/hr. Check the entire system to ensure there are no air bubbles.

Click the syringe into the clear bracket and slide the transducer down into the holder

Connect the cord into the cable aligning the arrow to the finger graphic

Scrub the hub with a 70% alcohol & 2% Chlorhexidine swab and allow to dry. Connect to the patient. Zero the transducer

Caveat: An increase to infusion rate must be documented in the patient's electronic medical record by a medical officer.

Sampling the arterial catheter

Sampling the arterial catheter is an accredited skill requiring reaccreditation second yearly. Detailed instructions on sampling the arterial catheter are listed [here](#).

Sampling from UAC

- Blood sampling from the umbilical artery catheter should be carried out slowly to decrease the risk of cerebral hypoperfusion⁹
- There is a direct relationship between the flow rate during flushing of the catheter and changes in cerebral blood flow velocity
- The recommended rate of withdrawal and flush is 1mL per 30 seconds to reduce the effect on the cerebral blood flow⁸

Care and management of arterial catheters

Assessment and management of UAC

- Infants with an umbilical artery catheter must be closely observed to avoid potential complications- see below table⁶
- Every 4 hours verify that the catheter is secure and still at the prescribed documented centimetre marking
- Position and protect the tubing to avoid accidental removal by the infant through entrapment of a finger or toe
- Practice good hand hygiene when handling the catheter, replacing the fluids or sampling from the catheter
- Use a closed infusion system to avoid the risk of air embolus, tubing contamination and catheter related blood stream infections
- Hourly monitor for vascular compromise which include; thrombosis, arterial vasospasm, ischaemia or infarction to an organ or an extremity

Complications of Umbilical Artery Catheters and Lines

| Complication | Signs | Causes | Intervention |
|----------------|---|---|---|
| Arterial Spasm | <ul style="list-style-type: none"> • Irregular or dampened waveform on the monitor | <ul style="list-style-type: none"> • Trauma or irritation to the artery by the catheter • Hypovolemia | <ul style="list-style-type: none"> • When taping- the catheter properly to prevent excessive movement of the catheter • Splint to immobilise limb |

| | | | |
|-------------------|--|---|---|
| | <ul style="list-style-type: none"> Reduced pulse below the arterial line <p>Distal sites; poor colour, cool to touch, sluggish capillary refill, unilateral discrepancy, reduced movement</p> | | <ul style="list-style-type: none"> Ensure adequate blood volume |
| Thrombosis | <ul style="list-style-type: none"> Weakened or lost pulse below the site Loss of warmth and perfusion to area distal to catheter No waveform | <ul style="list-style-type: none"> Failure to flush catheter Damage to artery on insertion Trauma to artery by a mobile catheter | <ul style="list-style-type: none"> Ensure pump running and heparinised saline is used for continuous and intermittent flushes Proper insertion, positioning and support of the line. |
| Aortic thrombosis | <ul style="list-style-type: none"> Dampened arterial waveform Hypertension Oliguria Haematuria Decreased perfusion to lower limbs | <ul style="list-style-type: none"> Failure to flush catheter Damage to artery on insertion Trauma to artery by a mobile catheter | <ul style="list-style-type: none"> Ensure pump running and heparinised saline is used for continuous and intermittent flushes Proper insertion, positioning and support of the line. |
| Air in line | <ul style="list-style-type: none"> Dampened wave form If there is air embolus change in infants vital signs – tachycardia, bradycardia, cyanosis, death | <ul style="list-style-type: none"> Air in tubing from loose connections Air in tubing from inadequate priming of line Air in tubing from bolus flushing of line containing air bubbles | <ul style="list-style-type: none"> Ensure connections are secure Ensure line is primed properly before use Ensure no air bubbles in flush solution both continuous and bolus or in blood being returned to infant post collection of ABG |

| | | | |
|--|--|--|---|
| | | | <ul style="list-style-type: none"> If embolus is suspected place infant on L side and seek immediate medical assistance |
| Infection | <ul style="list-style-type: none"> Inflammation of site Temperature instability and tachycardia, bradycardia | <ul style="list-style-type: none"> Poor aseptic technique and contamination of line Immature immune function and severity of illness | <ul style="list-style-type: none"> Care of line to prevent contamination |
| Bleeding from site or line. Haematoma | <ul style="list-style-type: none"> Bleeding evident Alarm audible if disconnection Swelling of limb or site | <ul style="list-style-type: none"> Disconnected line or catheter that has dislodged Coagulopathy | <ul style="list-style-type: none"> Check all connections on initial set up and then at least once per shift Ensure proper positioning and support of the line and taping of cannula |
| Ischaemic injury | <ul style="list-style-type: none"> White digits distal to the insertion site Duskiness to tips of digits | <ul style="list-style-type: none"> Decreased blood flow or thrombus in artery occluding flow distal to insertion site Unilateral discrepancy in distal extremities | <ul style="list-style-type: none"> Remove line immediately. Warm opposite limb with warm flannel (Do not use glove filled with warm water as this may result in a burn injury). Plastics team to review patient for consideration of Nitroglycerin topical application |

- Discontinue the UAC as soon as frequent blood sampling or continuous blood pressure monitoring is no longer required
- UAC are typically left in place up to seven days, complications specifically thrombosis increase with longer indwelling catheters
- Inadvertent dislodgement with or without blood loss
- Sepsis
- Thromboembolic: Distal emboli into the brain or systemic arteries are a rare occurrence
- Rarely necrotizing enterocolitis

- Longterm – patients may get portosystemic hypertension from occult thrombosis post UAC in the neonatal period

Removal of UACs

Removal of an umbilical venous line should only be performed by an accredited RN or trained medical officer. Refer to the [removal of UAC](#) document for further guidance on this procedure.

Removal of peripheral IALs

1. Turn off infusion
2. A second nurse should support the patient with swaddling, sucrose or expressed breast milk and a dummy.
3. Using an adhesive removal wipe such as Niltac® remove taping and cannula and apply direct pressure to site using a square of gauze folded into a small firm square.
4. Keep pressure on site until bleeding stops, this may take up to five minutes.

Post Removal

- Document the procedure in electronic medical record.
- Continue to observe for bleeding for at least 4 hours post line removal.

Patient Safety

- Only heparinised saline 1 unit/mL is infused
- Only inject normal or heparinised saline into the arterial line – no other medications or infusates are recommended
- The level of the transducer should be assessed at the commencement of each shift with a spirit level to ensure accurate calibration to the infant's phlebostatic axis
- Zero the transducer at the commencement of arterial pressure monitoring and the beginning of each shift (8hrly); and with the infants' change of position above or below the transducer
- Arterial pressure monitor alarms should not be turned off and alarm parameters should be checked each shift
- Alarms are set within 5 mmHg above and below the target MAP, and switched on at all times (outside of blood collection)
- Monitor the insertion site for bleeding and signs of infection and record findings hourly.
- The site must remain visible at all times. Site checks of the extremity for perfusion and possible digital embolism are attended hourly and documented on the flow chart in electronic medical record. Note any colour changes to limb periphery and inform the Medical Officer /Nurse Practitioner (NP) immediately.
- For peripheral lines, the limb must be secured to a splint and placed in a secure position to avoid the risk of accidental disconnection
- Sampling from the line is attended by accredited nurses or doctors

- Standard precautions should be observed when accessing the line. This should include the application of gloves and protective eye wear.
- All connections in the system must be Luer locked
- Ensure there are no air bubbles in the line, in flush solution, in bolus flush including returned blood from the SafeSet line
- No attempt should be made to flush a blocked arterial line

Nursing Care

- Any marked changes to the blood pressure and/or pressure waveform requires review of the patient to determine the cause and if necessary notification to the medical officer/ NP and the nurse in charge of shift
- The flushing solution is changed every 48 hours
- The arterial line giving set with transducer is replaced every Monday, Wednesday and Friday
- All re-tapings of the peripheral artery cannula are attended by a Medical Officer/ NP or under supervision of an experienced nurse
- A second nurse should be available for arterial line tubing changes to support the infant's limb
- Check the arterial site when flushing to determine if there is any compromise, such as severe blanching, in circulation
- Blood pressure is observed regularly for changes both in pressure reading and waveform
- Blood pressure results are documented hourly in the electronic medical record vital signs section
- Samples of blood are taken according to the infant's clinical condition or as ordered by medical or senior nursing staff

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