Arterial lines in Neonates – Catheterisation, Sampling and Management in NICU

Procedure Responsibilities and Authorisation

Department Responsible for Procedure	Newborn Intensive Care Unit
Document Facilitator Name	Aira Javier
Document Facilitator Title	Associate Charge Nurse Manager
Document Owner Name	Diane Taylor
Document Owner Title	Charge Nurse Manager
Target Audience	NICU staff
Disclaimer: This document has been developed for use specifically by staff at the former Waikato District Health Board. Caution should be exercised before use outside this district. Any reliance on the information contained herein by any third party is at their own risk and Health New Zealand | Te Whatu Ora assumes no responsibility whatsoever for any issues arising as a result of such reliance.	

Procedure Review History

Version	Updated by	Date Updated	Summary of Changes
1	Chloe Bateman Aira Javier	February 2024	Renamed and merged nursing and medical guidelines (1637 and 1638). Withdraw 1637 & 1638 Updated taping/securing of arterial lines, sampling and flushing, references

Arterial lines in Neonates – Catheterisation, Sampling and Management in NICU

Contents

Arterial lines in Neonates – Catheterisation, Sampling and Management in NICU

1 Overview

1.1 Purpose

- To maintain safety and comfort of infants during the insertion and maintenance of an indwelling arterial catheter/cannula in an umbilical artery or peripheral artery.
- To ensure blood specimens are obtained safely and minimise iatrogenic infant blood loss.
- To monitor infant's blood pressure (BP) and heart rate continuously.

1.2 Staff group

Registered Nurses and Medical Team working in the Neonatal Intensive Care Unit (NICU)

1.3 Patient / client group

Neonates and infants in NICU.

1.4 Definitions

ACNM	Associate Charge Nurse Manager
BP	Blood Pressure
CNS	Clinical Nurse Specialist
CVAD	Central Venous Access Device
ELBW	Extreme Low Birth Weight
NP	Nurse Practitioner
PAL	Peripheral Arterial Line
UAC	Umbilical Arterial Line

1.5 Competency required

Registered Nurse with Health NZ Waikato generic IV certification and NICU specific advanced Central Venous Access Device (CVAD) and UAC/PAL certification.

1.6 Special Notes

- **Umbilical catheter and PAL site must be visible at all times.**
- **UAC: Monitor circulations in lower limbs and buttock**
- **PAL: Monitor circulation of toes or fingers depending on site of the arterial line.**
- **All babies must have transducer with limits set appropriately.**
- **Do not nurse baby in cot.**
- **Alarms must be on at ALL times.**
- **It is essential that careful attention is paid to the positioning and taping of the line.**

Drugs must not be administered via UAC (unless expressly discussed with SMO):

- When no IV access is available, the UAC may be used for fluid administration (Intravenous Nutrition, Glucose 10%). Consultant/~~N~~NP/CNS/Registrar's approval is necessary.
- Baby must have transducer with limits set appropriately when the UAC is used for fluid administration to minimise the risk of accidental dislodgement of UAC or loose connections that will result in haemorrhage.

- Handling of UAC after insertion and confirmation of position: Apply aseptic non touch technique principles: hand hygiene, do not contaminate key parts, i.e. the hubs of syringes or ports of ampoules, use of gloves, clean surface to work on, e.g. sterile guard.
- For peripheral arterial cannulation, a clean aseptic technique is used and sterile gown or mask not required.
- Luer plug on arterial line are changed 8 hourly.
- Arterial line fluids are changed at 48 hours following initial insertion and fluid set up.

2 Insertion

2.1 Equipment

2.1.1 Equipment for UAC catheterisation and set up

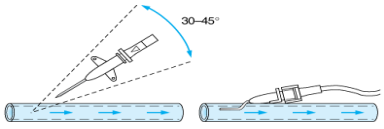
- Bedside Trolley, cleaned
- Umbilical insertion pack or Intra-Arterial (IA) line Tray
- Umbilical Arterial catheters, e.g. sizes 5 / 3.5 Fr
- 3-way tap
- Luer plug
- 10 ml syringe
- Blunt drawing up needle
- 10 ml vial of Sodium Chloride 0.9%
- Mask and hat
- Doctor / CVL gown pack
- Sterile drapes
- Sterile gloves
- Alcohol free chlorhexidine skin cleansing agents
- Sterile water
- Alcohol/chlorhexidine Prep pads
- Cord tie

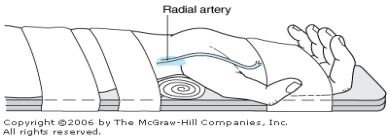
Continued over page

- One packet of 4.0 silk
- Blade
- Specimen container for umbilical cord

2.1.2 Equipment for PAL catheterisation and set up

- Sterile paper guard and clean trolley/surface
- IV cannula, e.g. Insite 24g/19mm
- Alcohol free chlorhexidine skin cleansing agents
- Alcohol/chlorhexidine Prep pads
- 3-way tap
- Luer plug
- 1ml and 5ml syringe for flush
- 10ml vial of sodium chloride 0.9%
- Short IV extension set
- Elastoplast white tape and Leukoplast brown tape for securing
- Tegaderm or OpSite as required
- Non sterile gloves
- Long splint with U-shaped bend (as per diagram)





2.2 Procedure

2.2.1 Catheterisation of UAC and PAL

1 Preparation

- Put “DO NOT ENTER/STOP” sign on nursery door to minimise traffic in the nursery.
- Collect equipment and arrange on cleaned bedside trolley.
- Raise incubator top or transfer infant to radiant warmer, attach temperature servo probe.
- Ensure ECG monitor and oximeter attached.
- Baby should be positioned on his/her back to ensure easy and safe insertion of UAC.

2 Preparing equipment

- Put on mask and hat.
- Perform hand hygiene.
- Open umbilical insertion pack or IA line tray.
- Open gown and gloves in a sterile matter.
- Assist NP/CNS/Registrar/SMO to gown up.
- Open sterile equipment onto a sterile field.
- Set up BP transducer and UAC fluids (Refer to section 2.3.2) or request assistant to do this if busy.

3 Insertion procedure by ~~N~~NP/CNS/Registrar/SMO

- NP/CNS/Registrar/SMO will arrange equipment on sterile field.
- Assistant cleans the neck of vial of sodium chloride 0.9% with Alcohol/Chlorhexidine Prep pads and hold the open vial so ~~N~~NP/CNS/Registrar/SMO can fill 10ml syringe and use this to prime the catheter, 3-way tap and luer plug.
- PAL – nurse will gently hold infant's limb and assist with taping.
- After procedure, dispose of sharps, equipment and rubbish in designated receptacles.

4 Confirming UAC placement

- UAC line placement must be confirmed by x-ray and verified by NP/CNS/Registrar staff before connecting fluids.

5 Commencing Fluids

- Commence fluid infusion immediately following insertion and securing of the PAL.
- Refer to Section 5 on how to secure a PAL.

6 Safety of infant

- Observe and monitor infant's condition throughout procedure to detect any changes.
- Whilst waiting for confirmation of UAC placement, ensure line is safely positioned/secured to avoid accidental dislodge of catheter and risk of haemorrhage.
- After insertion ascertain from NP/CNS/Registrar/SMO which catheter is UAC/UVC; and label the catheters correctly.

7 Documentation

- Procedures must be documented either on CVAD checklist (UAC) or as a procedure (PAL) in clinical notes.

3 Preparation and connection of arterial line fluids

3.1 Equipment

- Sterile paper guard
- 60ml BD syringe
- 500ml bag of sodium chloride 0.45%; occasionally sodium chloride 0.9% may be prescribed by NNP/CNS/Registrar
- Heparin ampoule (50 IU in 5ml)
- 5ml syringe
- Blunt fill needle
- Pressure monitoring transducer set
- AsenaTM syringe driver pump
- AsenaTM syringe driver extension set
- Bag access device
- Medication added labels
- Non-sterile gloves

3.2 Procedure

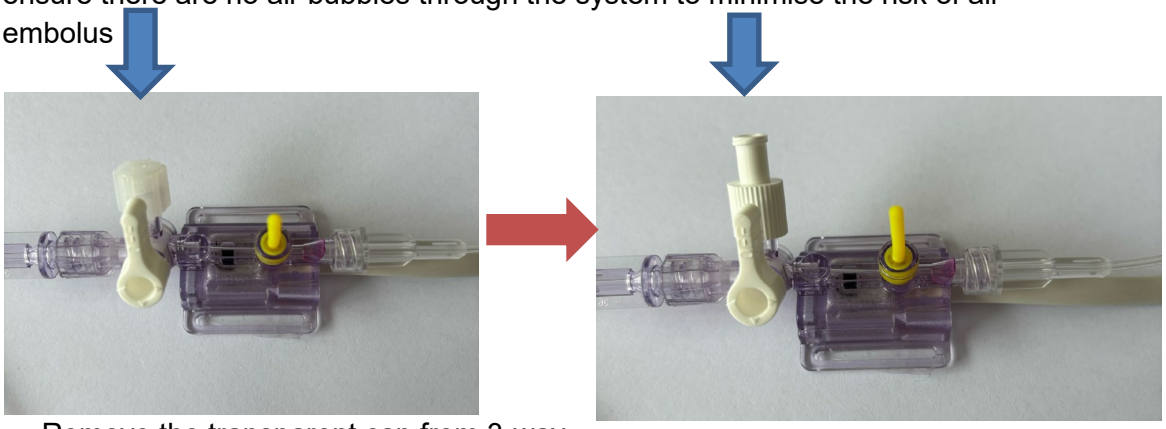
1 Prepare arterial line fluids

- Heparinised saline solution is used to reduce risk of thrombus formation in and around arterial catheter
- Collect equipment.
- Perform hand hygiene and wear non-sterile gloves.
- Open sterile guard and arrange equipment.
- Draw up heparinised saline as per Heparin sodium for neonates drug guideline
- Attach to Asena^{TM} extension set.
- Label syringe with a medication added label.
- Document line change on the patient's fluid form

2 Set up infusion and transducer system

- Maintain the principles of aseptic non touch technique to minimise risk of infection.
- Prime extension set with heparinised sodium chloride 0.45% solution.
- Attach extension set to transducer.

Pull the yellow coloured rubber valve on transducer while priming the lines slowly to ensure there are no air bubbles through the system to minimise the risk of air embolus



- Remove the transparent cap from 3-way tap on transducer and replace with white cap because transparent cap has a hole in it and must be replaced to maintain airtight system.
- Remove 3-way tap from end of wide bore transducer tubing and connect to baby's arterial catheter that has a 3-way tap already attached by NP/CNS/Registrar.

3 Connect new transducer to arterial line

- Request assistance from another RN.
- Place sterile guard with baby end of transducer line next to baby.
- Ensure 3-way tap on end of arterial catheter is OFF to baby to avoid accidental haemorrhage.
- Assistant to place syringe into Asena™ syringe pump, turn on and prime fluid through system to ensure pump has built up pressure in the line prior to connecting and to prevent high pressure arterial blood flowing back along catheter.
- Double check for air bubbles.
- Disconnect the 10ml syringe or old transducer line from 3-way tap on arterial catheter and connect the new line.

Note: When changing lines and fluid for an existing arterial line, the 3-way tap is not changed as it is treated as part of the catheter to prevent breakage/damage to the umbilical catheter.

- Set Asena™ syringe pump to deliver the volume of the prescribed fluid, e.g. 0.5ml/hr for UAC.

- For PAL, the infusion rate is 0.8 to 1ml/hour because peripheral artery is small and requires higher pressure to maintain patency.
- Ensure the arterial line fluid and infusion rate are prescribed daily by NP/CNS/Registrar on the *General Treatment Sheet*.
- Document fluid and line change on fluid forms.

4 Zero (calibrate) transducer

- Ensure the transducer is positioned at foot end of bed at level of baby's heart
- Connect the white plug from the transducer into the monitor invasive blood pressure cable.
- Ensure 3-way tap on arterial catheter remains off all ways (45 degrees) to prevent accidental haemorrhage.
- Turn 3-way tap on transducer off to baby.
- Remove white plug from transducer and open to air
- Press "Zero" key on Mindray monitor and wait until monitor says "zero complete" to ensure transducer is calibrated (zeroed) to the air pressure.
- Reconnect the white plug and turn on 3-way transducer tap first, and final step is to turn on 3-way tap on to baby's arterial catheter.
- Check all connections are secure.
- Observe monitor for return of blood pressure wave and reading to ensure transducer functioning and Blood Pressure (BP)/Mean Arterial Pressure (MAP) within normal parameters.
- Check alarm is on and set correctly to alert for change in pressure as this is critical in case of haemorrhage.
- Zero BP transducer after insertion, at beginning of each shift, after line change, and after any major movement of baby i.e. lifting or cuddle, to ensure accurate reading. Check the arterial waveform and pressure reading in the monitor.

5 After care

- Collect and dispose of rubbish and sharps in appropriate receptacle.
- Perform hand hygiene.

4 Securing UAC and PAL

4.1 Securing UAC

- Perform hand hygiene.
- Remove cord tie before securing the umbilical lines because the cord tie acts like a tourniquet immediately after the cord has been cut for insertion.
- Do not leave the cord tie on the umbilical stump because it will cause swelling of the umbilical stump but cannot help stop bleeding after insertion. Site needs to be carefully observed for bleeding after removing cord tie. Small amounts of oozing is common but this needs regular monitoring (1-hourly at the minimum). Any concerns should be escalated and addressed with appropriate haemostatic interventions (i.e. tightening cord tie, Surgicel™, further sutures if needed).
- Following confirmation of position by X-ray, bridge UAC securely using H-shape (bridge) method in diagram 1 below. Alternatively you can use the gate method please see diagram 2 and appendix.
- Assess skin of extreme low birth weight (ELBW), if possible avoid bridging the UAC for the first 5 days. Wrap Leukoplast around catheter and sutures just above insertion site to mark the level (position) of UAC above skin. If the baby is very active consider securing using the gate method please see diagram 2 and appendix.

Figure 1. H-shape/Bridge taping method

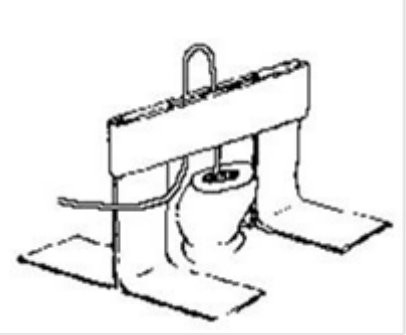


Figure 2. Abdominal taping

4.2 Securing PAL

- Secure the peripheral arterial cannula with tapes as you would a PIV using Steristrips and Tegaderm.
- Splint the limb (using an appropriate padded splint) and ensure extension set is stabilised. The board should extend beyond the end of the hand/ ankle enough to stabilise the line. Please see diagrams below.

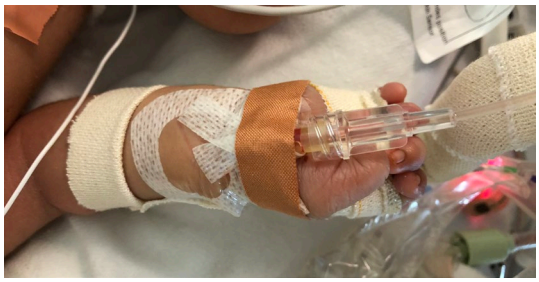


Diagram 3. Example of PAL taping

Diagram 4: Example of PAL secured, note gentle extension of wrist and extension set well stabilised.

- Ensure digits are visible for monitoring of colour and perfusion.

4.2.1 Maintain safety

- **Ensure UAC catheter measurement is documented on safety checklist and measurement is checked at the beginning of every shift.**
- Perform hand hygiene prior to accessing arterial line ports.
- Prime arterial lines and transducer using pump prior to connecting to baby – Zero transducer once connected.
- Ensure no air in line to prevent risk of air embolism.
- Ensure all connections are secure at commencement of shift, following major movement, e.g. turning or x-ray, and after each line access to reduce risk of haemorrhage.
- If bleeding from umbilical site occurs after insertion, apply pressure for 3-5 minutes until bleeding stops.
- Inform ~~N~~NNP/CNS/Registrar if bleeding is recurrent because other interventions or investigations might be required
- Observe for signs of blood leaking back into line as this can indicate a leak in the system.
- Observe insertion site and measurement regularly for signs of catheter migration.
- UAC site should be visible and not be covered by linen or other devices/items.

- Line insertion site and extremities must be monitored carefully and visually inspected at each observation. Check buttocks between sampling for signs of blanching/mottling if UAC in-situ.
- Inform NP/CNS/Registrar if any persistent mottling, blanching or colour change noted.
- Ensure arterial line alarm is on at all times.
- If line is alarming frequently, troubleshoot and discuss with ~~N~~NP/CNS/Registrar because alarm may indicate catheter becomes dislodged, leaking or blocked.
- Arterial blood pressure is high – baby can lose significant amounts of blood in a very short time if catheter becomes dislodged or leaking.
- Change the heparinised saline solution in syringe, extension set and transducer 48 hourly using aseptic technique.

Special notes:

- Two certified nurses are needed to check draw up and administer arterial line fluids.
- 3-way tap is not changed as it is treated as part of the catheter to prevent breakage/damage to catheter.
- Change the luer plug on the 3-way tap 8-hourly at beginning of shift, or more frequently if indicated to prevent clots on 3-way and reduce risk of infection.
- Arterial fluid types and rates, and mean arterial pressure (MAP) parameters must be prescribed by medical staff/NP/CNS/Registrar on daily treatment chart.
- Notify / NP/CNS/Registrar if BP or MAP consistently outside prescribed parameters to enable prompt intervention if blood pressure support is indicated.

5 Sampling from an Arterial Line

5.1 Equipment

UAC:

- Sterile paper guard
- 1 and 3ml luer lock syringes as required
- Blood gas syringe
- 1ml heparinised sodium chloride 0.45% flush
- Blood collection tubes
- Gauze swabs
- Alcohol-chlorhexidine prep pad
- Non-sterile gloves
- Patient labels
- Laboratory specimen bag and laboratory form

PAL:

- As above but only 1ml syringes
  - Extra 1ml syringe for peripheral IV flush after dead space return

NB: Each infant with an arterial line needs a heparinised 0.45% sodium chloride flush prepared in a 10-20ml syringe at the beginning of each shift and left at the bedside to be used for arterial line flushes. At the end of each shift discard unused solution and syringe in designated receptacles.
Prepare heparinised saline as per the NICU Heparin drug guideline.
Heparin sodium for neonates (Ref. 2925).

5.2 Procedure

5.2.1 Preparations

- Check that the blood gas machine is ready prior to collecting sample.
- Identify the correct patient.
- Collect equipment and arrange at bedside.
- Perform hand hygiene.
- Wear nonsterile gloves every time you access the UAC or PAL especially during blood sampling.

5.2.2 Withdrawing dead-space

- Place sterile guard under arterial line 3-way tap next to baby and arrange equipment on sterile guard.
- Swab luer plug with alcohol-chlorhexidine swab for at least 15 seconds and allow 15 seconds drying time.
- Turn 3-way tap off all ways (45 degrees)
- Attach empty 3ml syringe (or 1ml syringe if sampling from PAL), turn 3-way tap on to baby and luer and withdraw slowly and gently 1.5 ml of dead-space from the UAC and 1.0 ml from PAL to remove heparinised saline from line.
- Turn 3-way tap off all ways (45 degrees) before removing syringe.
- Place syringe on sterile guard.

Diagram 5: Example of 3-way tap off all ways

Special notes:

- Withdraw dead space and blood slowly and gently (no faster than 1ml over 30 seconds) because rapid withdrawal of blood can affect cerebral blood flow velocity, volume and oxygenation. Fluctuation of cerebral flow in premature infants has been correlated with incidence of intraventricular haemorrhage and periventricular leukomalacia.
- If blood sample is requested for special tests, e.g. coagulation study, a larger volume of dead space (3-5mls) will be required to ensure the sample is not contaminated by the contents of the infusing fluid. Check with CNS/NP/Registrar or ACNM/Coordinator.
- It is recommended to be a two-person procedure, particularly in obtaining a large volume of blood samples.
- The 3-way tap should be turned off all ways (45 degrees) every time before either attaching or detaching a syringe. To do this, position midway between the infusing fluid and syringe connection, this ensures blood will not be flowing out from the 3-way tap and the infusing fluid is not entering the gas syringe.

5.2.3 Withdrawing blood samples

- Turn 3-way tap off all ways.
- Attach gas syringe while ensuring the 3-way tap is still off from baby and infusing fluid.
- Turn off 3-way tap to infusing fluid and on to baby.
- Withdraw blood 0.3ml slowly and gently for blood gas because slow withdrawal decreases arterial spasm and prevents inadvertent aspiration of air.
- Remove any air from the syringe as it may affect blood gas result.
- Roll gas syringe for 20 seconds and invert the syringe 4 times to ensure the blood sample is adequately mixed with anticoagulant. If using a capillary tube mix 10 times slowly along the tube with flea and magnet – run the magnet past the red caps to ensure flea is taken right to the end of each tube. Turn 3-way tap off all ways before removing syringe.
- Take other required blood samples; withdraw blood slowly and gently as above.
- Transfer blood to appropriate specimen tubes, cap and invert gently 10 times.

5.2.4 Returning dead-space

- Return dead-space to minimise iatrogenic blood loss.
- Ensure no air is present in syringe then return dead-space slowly and gently to prevent arterial spasm and rapid return.
- UAC - dead-space return via UAC
- PAL – dead-space return via peripheral IV. If no peripheral IV, you can return through the PAL, return blood slowly and monitor PAL insertion site closely for blanching.
- Flush line slowly and gently with heparinised sodium chloride 0.45% post dead-space return to clear blood from line. Flush PAL with 0.5-1.0ml heparinised saline carefully until line is completely clear.
- Turn 3-way tap on to infusion and baby.
- Check waveform, alarms on and recording of BP resume on monitor. Check colour, warmth, and sensation of limbs.

Special notes:
Return dead-space and flush line slowly and gently (no faster than 1ml over 30 seconds) because rapid flushing can affect cerebral blood flow velocity, volume and oxygenation. Alternation of cerebral flow in premature infants has been correlated with incidence of intraventricular haemorrhage and periventricular leukomalacia.

5.2.5 Labelling blood samples

- Label all specimens with infant label, check label against blood test form, place in specimen bag and send to laboratory via Lamson system.
- Label blood gas with large patient label with barcode and process as per point of care testing (POCT) procedure.

5.2.6 After care

- Dispose of used equipment in appropriate receptacles.
- Perform hand hygiene.

Record results of blood gas and electrolytes on infant flow sheet and sign, and show results to NP/CNS/Registrar to enable prompt intervention based on results

5.2.7 Observations

- Monitor perfusion distal to arterial line insertion site:

UAC:

- Monitor buttocks, legs and feet for blanching, sensation, colour, warmth and perfusion for early identification of compromised perfusion.
- Insertion site and extremities must be visible at all times.
- If UAC in situ, monitor peripheral temperature (axillary or upper body) as circulation to lower limbs may be compromised with umbilical line.
- Nurse infant supine for at least 4 hours post line insertion (or longer if significant oozing present).
    - Infant may be nursed prone after this if warranted for respiratory distress as directed by senior medical staff. (**NOTE**: ensure hourly vigilant observation of umbilical site if infant is nursed in prone position).

PAL:

- Monitor limb and digits above and below arterial line insertion site for blanching or colour change. Some blanching may occur during PAL flushing, but should resolve within 15-20 minutes.
- Inform NP/CNS/Registrar if any persistent mottling, blanching or colour change noted.
- Monitor BP and MAP, waveform and heart rate.
    - Inform NP/CNS/registrar if BP/MAP consistently outside prescribed parameters to enable prompt intervention if blood pressure support is indicated.
- Pulse rate can be obtained via arterial line or SpO2 monitoring for ELBW infant whose skin is very delicate and chest electrodes should not be applied.

5.2.8 Documentation

- Record fluid volume and rate hourly on daily fluid balance record.
- Record BP & MAP hourly on observation chart.
- Document and report any problems of BP or MAP outside the prescribed parameters and perfusion and colour of buttocks and limbs.
- Record the volume of blood taken from the neonate on the patient observation chart fluid balance.

6 Removal of umbilical arterial catheters

Equipment

- Sterile dressing pack
- Chlorhexidine alcohol free cleansing agents
- Sterile suture removal pack
- Cavilon™ pads
- Spare gauze swabs
- Sterile gloves
- Rubbish bag
- Trolley cleaned with Hyposal

Preparations

- Perform hand hygiene.
- Collect equipment and place on trolley.
- Open up dressing pack onto trolley and place equipment on sterile field.
- Open gloves onto surface, maintaining sterility.
- Remove bridge tapes carefully using water or Cavilon™ stick to break hydrocolloid base tape adhesion, leave Duoderm if very firmly adhered to skin. Use sterile water for ELBW babies.

Remove catheter

- Perform hand hygiene.
- Put on sterile gloves.
- Arrange equipment on sterile field.
- Ask assistant to turn off arterial line infusion pump when ready to remove the UAC.
- **Stop infusion just prior to removal of catheter because prolonged stasis can cause thrombus formation or vessel occlusion.**

- Place paper guard on baby's trunk.
- Clean area around UAC and remove suture.
- Over several minutes, slowly withdraw catheter to 5cm, maintain pressure on umbilicus for 5 minutes to encourage vessel constriction.
- Maintain pressure at base of stump, not from above, to prevent haemorrhage from umbilical artery: grasp stump between thumb and index finger in a pincer grip. This will occlude the vessel.
- Withdraw last 5cm slowly over 2-3 minutes maintaining pressure on umbilicus.
- Apply firm pressure to umbilicus with gauze swab when catheter is completely removed for a minimum of 5 minutes to prevent haemorrhage as artery may have lost ability to spasm.
- Check for oozing. If umbilicus continues to ooze, continue applying firm pressure for a minimum of another 5 minutes until oozing ceases.

Observations

- Ensure infant is not nursed prone for 4 hours after catheter is removed.
- Nurse infant supine in incubator or on Ohio to ensure umbilicus remains visible to observe for haemorrhage.
- Observe umbilicus frequently for ½ hour after line removal.
- Observe for any further oozing or active bleeding. Check the lower extremities and buttocks for diminished perfusion
- Check catheter before disposal to ensure it is intact and has been completely removed.

After care

- Dispose of equipment into designated containers.
- Perform hand hygiene.
- Document procedure and reason for removal in clinical notes.

Removal of peripheral arterial catheters

- Peripheral arterial catheters may be removed in the same manner as a peripheral IV cannula.
- Following removal apply pressure to insertion site for a minimum of 5 minutes to ensure bleeding stop.
- Cover with a small gauze square and OpSite™ or Tegaderm™ dressing. This dressing may be removed after 24 hours.
- Observe dressing for signs of oozing or bleeding. Document procedure in clinical notes.

7 Trouble Shooting

Loss of BP trace or unable to sample from the line.

- Check colour and perfusion distal to insertion site.
- Ensure that the line is still in place and has not dislodged.
- Reposition splint/limb (PAL).
- Ensure no kinks or occlusions in line and that both 3-way taps are in correct position for infusion.
- Check giving set and BP transducer for back flow - flush line if necessary.
- Gently aspirate from the line then then flush.
- Check and/or adjust BP scale on monitor.
- Allow artery time to recover - may be in vasospasm from previous attempt. Check colour and perfusion of limb and digits after 2-3 minutes. If satisfactory, gently try to aspirate/flush again.
- Consider removing dressing to check and/or reposition cannula if needed. Consult with NP/CNS/Registrar before doing this.
- If unsure or not able to troubleshoot, notify NP/CNS/Registrar for assistance.

8 Potential complications

Malposition of catheter	• Vessel perforation • Refractory hypoglycaemia (if catheter tip opposite coeliac axis) • Peritoneal perforation • False aneurysm
Vascular accident	• Thrombosis • Embolism/Infarction • Vasospasm • Loss of extremity • Hypertension • Paraplegia • Heart failure (from aortic thrombosis) • Air embolism
Equipment related	• Broken catheter • Transection of catheter • Plasticizer in tissues • Improper grounding of electronic equipment • Conduction of current through fluid-filled catheter
Other	• Haemorrhage • Infection • Necrotising enterocolitis • Intestinal necrosis or perforation

8.1 Management of Complications

Tissue ischaemia is a serious complication that can result from use of arterial lines and is caused by vasospasm or thrombus/embolism. It is a serious complication and should be managed in a timely manner to ensure return of tissue perfusion as soon as possible.

Tissue ischaemia is identified by the presence of:

- Skin mottling
- Pallor
- Cyanosis
- Paralysis
- Absent limb pulses
- Reduced capillary refill.

If you notice any signs of tissue ischemia or are concerned about any other complications:

- Inform NP/CNS/Registrar immediately so the line can be assessed. Generally the line must be removed at the first sign of perfusion changes.
- Doppler can be used to confirm and locate the level of thrombus or identify arterial spasm.
- Stimulate reflex vasodilatation: A warm compress can be applied to the unaffected limb while elevating the affected limb. Arterial spasm should resolve within 6-8 hours. During this time ultrasound Doppler should be performed.
- In some severe cases anticoagulation using heparin may be required.

9 Audit

9.1 Indicators

- 100% of arterial lines are secured in accordance with this procedure
- Clinical records demonstrate that physiological observations are performed as per 2.4.4. (including intervals for observations)

10 Evidence base

10.1 References

- Caple, C. (2014). Umbilical catheter placement and care: Performing. Nursing practice and skills. Glendale: Cinahl Information Systems.
- Crabtree, L. & Sharkey, D. (2016). Umbilical and peripheral arterial lines. Nottingham Neonatal service-Clinical Guidelines. Retrieved from https://www.nuh.nhs.uk/download.cfm?doc=docm93jijm4n955.pdf&ver=5066.
- Firth, C., Vasudevan, C., & Carol Hudson, C. (2021). Insertion of Umbilical Lines in Neonates. Retrieved from: https://www.bradfordhospitals.nhs.uk/wp-content/uploads/2021/05/Insertion-of-Umbilical-Lines-in-Neonates.pdf
- Gardner, Carter, Enzman-Hines, Niermeyer, 5 February 2020, Handbook of Neonatal Intensive Care: An Interprofessional Approach (9th Ed). Missouri, St. Louis: Elsevier Saunders
- Gardner, S. et al. (ed.) (2016) *Merenstein & Gardner's Handbook of Neonatal Intensive Care, 8th Edition* (on-line resource electronic book). St. Louis, Missouri: Elsevier.
- Gordon, M., Bartruff, L., Gordon, S., Lofgren, M., & Widness, J. A. (2008). How fast is too fast? a practice change in umbilical arterial catheter blood sampling using the Iowa Model for Evidence-Based Practice. *Advances in neonatal care : official journal of the National Association of Neonatal Nurses*, *8*(4), 198–207. https://doi.org/10.1097/01.ANC.0000333707.37776.08
- Government of Western Australia Child and Adolescent Health Services. (2021). Peripheral Arterial Catheter Insertion and Removal. https://www.cahs.health.wa.gov.au/-/media/HSPs/CAHS/Documents/Health-Professionals/Neonatology-guidelines/Peripheral-Arterial-Catheter-Insertion-and-Removal.pdf
- Newborn Services Clinical Practice Committee, 16 July 2021. Peripheral Arterial Lines in the Neonate, Starship Child Health, https://starship.org.nz/guidelines/peripheral-arterial-lines/
- Newborn Services Clinical Practice Committee, 17 January 2022, Umbilical Artery and Vein Catherisation in the Neonate, Starship Child Health, https://starship.org.nz/guidelines/umbilical-artery-and-vein-catheterisation-in-the-neonate/

- NHS Networks (2017). Umbilical artery catheterisation and removal. *Neonatal Guidelines 2017-2019*, 343-345. Retrieved from www.networks.nhsuk/nhs-networks/staffordshire-shopshire-and-black-country-newborn/neonatalguideline
- Starship Child Health. How to secure UVC and UAC catheters. Retrieved from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://media.starship.org.nz/securing%2Fgating-of-uvc%2Fuac/Securing_umbilical_linesv2.pdf
- Verklan, M.T. & Walden, M. (2014) Core curriculum for neonatal intensive care nursing (5th Ed). Missouri, St Louis: Elsevier Saunders.
- Wolters Kluwer, 21 February 2020, Arterial catheter removal, paediatric. Lippincott Procedures. https://procedures.lww.com/lnp/view.do?pId=1233070&disciplineId=493
- Wolter Kluwer, 21 August 2020, Arterial pressure closed monitoring system blood sampling, paediatric. Lippincott Procedure. https://procedures.lww.com/lnp/view.do?pId=728878&disciplineId=493
- Wolter Kluwer, 21 August 2020, Arterial pressure monitoring, pediatric, Lippincott Procedure, https://procedures.lww.com/lnp/view.do?pId=728879&disciplineId=493

10.2 Associated Health NZ Waikato Documents

- Admission to Level III Intensive Care Nursery (Ref. 4571)
- Care of Ventilated Infant (Ref. 0432)
- ELBW Baby Care & NICU IVH Bundle of Care: For Infants with expected birthweight <1000g and/or GA <28weeks (Ref. 6240)
- Heparin sodium for neonates (Ref. 2925)
- Medicines Management policy (0138)
- NICU Drug manual

Appendix A – Gate method of securing UVC and UAC

Step 1: Gather the equipment needed – duoderm, clean scissors, Steristrips, Tegaderm.	
Step 2: After UAC has been x-rayed and placement confirmed, clean the baby's skin with warm sterile water and gauze and allow to dry. Place a small piece of Duoderm on the baby's abdomen to the side of the umbilicus.	
Step 3: Loop the catheter once, ensure the numbers on the catheter are visible and secure with a Steristrip.	
Step 4: Secure the catheter with Tegaderm.