

Arterial lines in Neonates – sampling, nursing management and removal

Procedure Responsibilities and Authorisation

Department Responsible for Procedure	Newborn Intensive Care Unit
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Target Audience	Nurses in NICU
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Procedure Review History

Version	Updated by	Date Updated	Summary of Changes
2	Leanne Baker	Nov 2011	Due for review
3	Joyce Mok	March 2015	Due for review
4	Richard Pagdanganan	July 2019	Due for review

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1 Overview

1.1 Purpose

- To maintain safety and comfort of infants with 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 Scope

Waikato District Health Board (DHB) staff working in NICU.

1.3 Patient / client group

Neonates and infants in NICU

1.4 Definitions

BP	Blood Pressure
CNS	Clinical Nurse Specialist
CVL	Central Venous Line
ELBW	Extreme Low Birth Weight
NNP	Neonatal Nurse Practitioner
PAL	Peripheral Arterial Line
UAC	Umbilical Arterial Line
ACNM	Associate Charge Nurse Manager

2 Clinical Management

2.1 Competency required

Registered Nurse with Waikato DHB generic IV certification and NICU specific advanced Central Venous Line (CVL) and UAC/PAL certification.

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2.2 Equipment

UAC:

- Sterile paper guard
- 1 and 2ml 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.

2.3 Procedure

2.3.1 Preparations

- Check blood gas machine ready.
- Collect equipment and arrange at bedside.
- Perform hand hygiene.
- Wear nonsterile gloves every time you access the UAC or PAL especially during blood sampling.

2.3.2 Withdrawing dead-space

- Place sterile guard under arterial line 3-way tap next to baby and arrange equipment on guard.
- Swab luer plug with alcohol-chlorhexidine swab and allow drying time.
- Turn 3-way tap off to baby.
- Attach empty 1ml syringe, turn 3-way tap on to baby and luer and withdraw slowly and gently 1.5 ml of dead-space from the UAC and 0.9 ml from PAL to remove heparinised saline from line.
- Turn 3-way tap off all ways before removing syringe.

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- Place syringe on sterile guard.

Special notes:

- Withdraw dead space and blood slowly and gently because rapid withdrawal of blood 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.
- 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/NNP/Registrar or ACNM/Coordinator.

2.3.3 Withdrawing blood samples

- Turn 3-way tap to a position midway between the infusing fluid and syringe connection to ensure blood will not be flowing out from the 3-way tap and the infusing fluid is not entering the gas syringe.
- 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.
- Withdraw blood 0.3ml slowly and gently for blood gas because slow withdrawal decreases arterial spasm and prevents inadvertent aspiration of air.
- Roll syringe 20 times to mix, to ensure blood sample adequately mixed with anticoagulant.
- 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.

2.3.4 Returning dead-space

- Return dead-space to minimise iatrogenic blood loss.
- 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
- Flush line slowly and gently with heparinised sodium chloride 0.45% post dead-space return and clear blood from line following return of dead-space.
- Turn 3-way tap on to infusion and baby.
- Check waveform, alarms on and recording of BP resume on monitor.

Special notes:

Return dead-space and flush line slowly and gently because rapid flushing can affect cerebral blood flow velocity, volume and oxygenation. Alternation of cerebral flow in

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premature infants has been correlated with incidence of intraventricular haemorrhage and periventricular leukomalacia.

2.3.5 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.

2.3.6 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 medical staff to enable prompt intervention based on results.

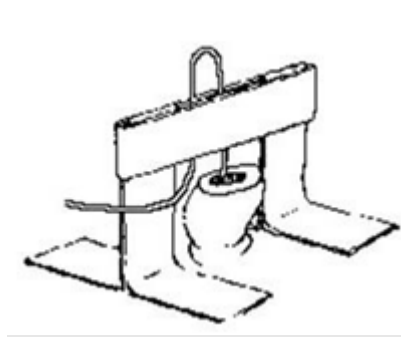
2.4 Nursing Management

2.4.1 Securing UAC

- Perform hand hygiene.
- Following confirmation of position by X-ray, bridge UAC securely.
- 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.
- Apply duoderm to protect skin, especially for very preterm baby to avoid skin damage in very preterm skin.
- Assess skin of extreme low birth weight (ELBW) infant – may need alternative method of securing until skin matures: wrap leucoplast around catheter and sutures just above insertion site to mark the level (position) of UAC above skin.
- Use H-shape taping technique (bridge) to secure the UAC to avoid accidental dislodging of catheter and haemorrhage. Refer to diagram below.

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2.4.2 Maintain safety

- Perform hand hygiene prior to accessing arterial line ports.
- Prime arterial lines and transducer using pump prior to connecting to baby.
- 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 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 blood in line can indicate a leak in the system.
 - Observe insertion site and measurement regularly for signs of catheter migration.
 - Position baby on side, head in midline, well nested in a flexed position with insertion site of UAC/PAL visible at all times.
 - Do not nurse prone or with booties on as line insertion site and extremities must be visible at all times.
 - Inform NNP/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, assess why and discuss with NNP/CNS/Registrar because alarm may indicate catheter becomes dislodge, 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 arterial line fluids 48 hourly using clean technique.
 - Change the heparinised saline solution in syringe, extension set and transducer 48 hourly.

Special notes:

- Two certified nurses 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.

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- 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/NNS/CNS on daily treatment chart.
- Notify /NNP/CNS/Registrar if BP or MAP consistently outside prescribed parameters to ensure MAP remains within prescribed parameters and enable prompt intervention if blood pressure support is indicated.
- This procedure is used in conjunction with Waikato DHB NICU Nursing Procedure: *Arterial line catheterisation and set up (1637)*.

2.4.3 Calibrate (zero) transducer

- Position transducer at foot end of bed at level of baby's heart
- Zero BP transducer after insertion, at beginning of each shift, and after line change to ensure accurate reading.

2.4.4 Observations

- Monitor perfusion distal to arterial line insertion site:

UAC:

- monitor buttocks, legs and feet for blanching, colour and perfusion for early identification of compromised perfusion.
- Do not nurse prone or with booties on as line insertion site and extremities must be visible at all times.
- If UAC in situ, monitor peripheral temperature on hand because circulation to lower limbs may be compromised with umbilical line.

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 NNP/CNS/Registrar if any persistent mottling, blanching or colour change noted.
- Monitor BP and MAP, waveform and heart rate.
 - Inform NNP/CNS/registrar if BP/MAP consistently outside prescribed parameters to ensure MAP remains within prescribed parameters and 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.

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2.4.5 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.

2.4.6 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 Tuffly™ wipes

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.

2 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 prolong stasis can cause thrombus formation or vessel occlusion.**
- Place paper guard on baby's trunk.
- Clean area around UAC and remove suture.

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- 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 2-4 hours after catheter is removed.
- Nurse infant supine in incubator or on radiant heater to ensure umbilicus remains visible to observe for haemorrhage.
- Observe umbilicus frequently for ½ hour after line removal.
- Observe for any further oozing.
- 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 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.

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3 Audit

3.1 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)
- No infants, with an arterial line, are nursed prone or with coverings on their extremities such as booties.

4 Evidence base

4.1 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=docm93jjjm4n955.pdf&ver=5066>.
- Verklan, M.T. & Walden, M. (2014) Core curriculum for neonatal intensive care nursing (5th Ed). Missouri, St Louis: Elsevier Saunders.
- Wolters Kluwer (2019). Arterial catheter removal, pediatric. *Lippincott Procedures*.
- Wolter Kluwer (2018). Arterial pressure closed monitoring system blood sampling, pediatric. *Lippincott Procedure*.

4.2 Associated Waikato DHB Documents

- Waikato DHB [Medicines Management](#) policy (0138)
- Waikato DHB NICU Drug manual
- Waikato DHB NICU Nursing Procedure: [Admission to Level III Intensive Care Nursery](#) (4571)
- Waikato DHB NICU Nursing Procedure: [Care of Ventilated Infant](#) (0432)
- Waikato DHB ELBW Baby Care & NICU IVH Bundle of Care: For Infants with expected birthweight <1000g and/or GA <28weeks

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