

Paediatric Intensive Care Unit Nursing Procedure: **Care of Arterial Lines.**

Definition: Arterial Line - Placement of an indwelling arterial catheter for the purpose of continuous monitoring of intra-arterial blood pressure and frequent sampling of arterial blood.

Introduction - Arterial cannula insertion is often indicated in patients in PICU during short periods of acute/critical illness. They may be sited using percutaneous puncture. (Ref 2)

Sites recommended for arterial lines:

- Radial Artery,
- Femoral Artery,
- Axillary Artery,
- Dorsalis Pedis,
- Umbilical Artery (may be used in newborn but is not covered within this document).

Equipment – Components of pressure monitoring system are:

- Indwelling cannula,
- Arterial line set,
- Flush system attached to syringe pump or pressure bag,
- Transducer ,
- Monitor.

All nursing staff involved in caring for a patient with an indwelling arterial cannula must be trained and competent to manage them. This includes:

- Understanding associated risks,
- Accessing lines,
- Maintaining patency,
- Recognising and managing potential difficulties.

Cannulation

Arterial cannulation should only be taken by a suitably qualified, competent practitioner. The different sites include:

- **Radial Artery**, this is the preferred site because the collateral blood supply is good, it is easily palpated and there is a reduced risk of infection compared to femoral access.
- **Femoral**
- **Axillary.**

Umbilical arteries may be used in the newborn (not included in this guideline)

The Brachial artery is not recommended if other sites are available, as this is an end artery.

Calibration

The transducer must be calibrated:-

- Following insertion of arterial cannula, this ensures the haemodynamic measurements are accurate.
- At the beginning of every shift, so the nurse can personally insure accuracy of measurement.
- When the child position has changed, i.e., bed height moved or bed sat up, as this can alter the measurement.

For calibration, the transducer must be level with the right atrium. This is identified as the 4th intercostal space and follows the chest wall to mid Axillary line. This ensures accurate measurement of the intra-arterial pressures.

To calibrate the transducer:

- Level the transducer with the atrium using a spirit level.
- Turn transducer tap off to patient and open to air
- Press “invasive pressures” on the monitor and then press “zero”. The monitor will confirm when process is complete.
- Close port that had been opened to air
- Open transducer tap to patient.

- The trace should be labelled on the monitor as Art so a clear trace can be seen and identified.

- The alarms should be set within acceptable limits for age/condition. The consultant often asks for a set limit of MABP if child has a large fluid requirement or requiring Inotropes.

Preparing transducer sets/lines.

Assembly of the appropriate monitoring system must be carried out by a suitable trained practitioner. We currently use two systems on the unit, one for under 10 kg and one over 10 kg. Both use Edwards's Lifesciences pressure monitoring set.

Under 10kgs.

A syringe driver is used with a pre made up syringe of 0.5 units per ml of 0.45% sodium chloride. The spike set from the transducer set is replaced with a 200 cm lectro-cath, and the distal line replaced with 15 cm lectro-cath.

Over 10 kgs

The full pressure monitoring set is used, and 500 ml bag of 0.9% sodium chloride, and a pressure bag.

When priming the line use a clean, non touch technique. Ensure all air is thoroughly removed from the line, all connections are secured, primed and airtight and all ports have been primed

Always ensure the system is labelled clearly and correctly, at transducer, sampling port, and at cannula site.

Maintaining patency.

The prescribed fluid (as for weight) needs to be delivered under pressure to maintain patency of cannula, minimise blood loss, prevent potential for backflow into the system, and to reduce the risk of clotting and loss of access.

Under 10kgs

Use pre-made syringes as prescribed and run at 1 ml/hr continuous via syringe driver.

10-40 kgs

Run prescribed fluid via the pressure bag, at 1.5 mls/hr. This will read as a pressure of 150mmhg on the pressure bag. There are a variety of mechanisms on the market for reading this pressure either in a push down valve or a dial.

40kg +

Run prescribed fluid via the pressure bag at 3 mls/hr.

Following blood sampling, always flush the line with 0.9% sodium chloride, using the minimal amount required to clear the line of blood. (This reduces the administration of unknown quantities of fluid.

N.B. Transducer sets must be changed every 72 hours,
Or more often if indicated, to reduce the risk of infection.

Pressure Monitoring.

Analysis of an arterial wave form provides valuable information as well as the systolic, diastolic and mean blood pressure.

To ensure the continuous, accurate blood pressure monitoring, the nurse should ensure

- The monitor is set to display arterial blood pressure trace and numerical values. If altered waveform is observed, take the appropriate action to resolve the problem.
- It is recommended to have the "ART" setup as S/D/M
- Continuous observation of pressure trace
- Appropriate alarm limits have been set
- That there is clear documentation of blood pressure, frequency dictated by patient's condition.
- Hourly documentation of fluid delivered via flush system.

Arterial blood pressure recording may be compared to non-invasive blood pressure when required, this can help establish base line observations in the case of arterial line failure, ensure accuracy of information obtained.

Sampling

Only staff that have received the appropriate training and have been assessed as competent should undertake blood sampling for an arterial line.

Be aware and stop sampling if

1. Resistance is felt (sign of blockage/fibrin sheath)
2. The child reports pain
3. Swelling is observed around the entry site
4. Leakage of fluid onto dressing
5. Redness or blanching around arterial site or along artery.

These could be a sign of line dislodgement, thrombosis, extravation/infiltration, infection or phlebitis.

Family

Explain to the family/carers and child that a blood sample is needed, the reason why, what the procedure entails and when the results are likely to be available. Is to help reduce anxiety and consent be given.

Equipment

- Blood sample bottles and investigation requests.
- Alcohol impregnated wipes

- Syringes required for blood samples (usually 5/10ml) depending how much blood is required
- Ampoule of 0.9% sodium chloride
- 2 x 2ml syringes
- Blood gas syringe
- Protective sheet/paper towel
- Non-sterile gloves
- Aprons
- Visors if appropriate.

N.B wash hands in accordance with the infection control policy.

Procedure

1. Put on clean apron
2. Wash hands
3. Gather equipment needed and open packaging
4. Place opened equipment in opened packaging onto disposable tray
5. Repeat hand wash and put on non-sterile gloves
6. Place protective sheet/paper towel under sampling port (the protect child and surrounding area from potential blood spillage).
7. Press silence alarm on monitor.
8. Clean sample port with alcohol impregnated wipe and allow to dry naturally.
9. Place 2 ml syringe into access port nearest the patient. (to reduce the amount of blood needed to be pulled off for a non diluted sample)
10. Turn 3 way tap to flush
11. Aspirate 2ml – 5mls of blood
12. Turn 3 way tap $\frac{1}{4}$ to stop blood flowing back
13. Remove filled syringe, and place in blood gas syringe.
14. Reopen 3 way tap
15. Aspirate 1 ml of blood into blood gas syringe.
16. Close 3 way tap, remove blood gas syringe, cap and replace with 5-10 ml syringe for collection of blood samples.
17. Reopen and aspirate amount required for test (so not to blood is aspirated and wasted).
18. Close 3 way tap, remove blood sample, place diluted blood syringe from first sample into port.
19. Open 3 way tap, Slowly replace diluted blood (to reduce arterial spasm)
20. Close tap, remove empty syringe, place syringe with 0.9% sodium chloride
21. Reopen tape and slowly flush fluid until all blood is removed from the line.
22. Switch monitor back on
23. Observe the trace, check parameters (to check patency of line and accurate monitoring purposes
24. Place blood in appropriate bottles as requested
25. Dispose equipment in line with local policy
26. Wash hands
27. Record blood sample and results in the child's records

Nursing care

Observation

The cannula must be secured with a sterile clean dressing, exposed and continuously observed. The patient must NOT be left unattended. This is to ensure that the site can be observed, minimise risk of accidental dislodgement, blood loss, infection and site related complications, and to maintain patient safety.

Circulation of the cannulated limb should be continuously monitored for signs of the following.

- Cyanosis
- Decreased pulse
- Blanched colour
- Cool skin/extremities
- Sluggish capillary refill time
- Bleeding

Any concerns or abnormalities should be reported to medical staff and the nurse in charge. These signs could indicate decreased blood flow distal to the cannula entry site, arterial spasm and clot formation.

The cannula MUST be removed if there is a sustained blanching to the limb, to help ensure the circulation to the limb is maintained.

Signs of cannula displacement include

- Swelling
- Bleeding
- Poor arterial waveform
- Fluid leakage
- Blanching
- Pain and discomfort.

Signs of infection include

- Pain
- Swelling
- Redness
- Pus
- Pyrexia
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If any of these signs are observed, they should be reported to the medical team and nurse in charge, to ensure the infection is recognised and treated early.

Should the cannula be accidentally removed, a pressure dressing should be applied to the area until bleeding is stopped and a sterile dressing applied.

Site Care

The cannula must be anchored with sutures or steristrips and secured with a sterile clear dressing, such as tegaderm i.v. This to ensure that the site is easily observed and reduced risk of infection and accidental dislodgement.

When doing dressing changes ensure that you have a second person available to avoid accidental dislodgement and extra hand with complicated removal of dressing without accidental removal.

Change dressing when

- It is ineffective at securing the cannula
- Is not keeping site clean and dry
- The cannula is obviously kinked
- Bleeding, leaking has occurred

To change an arterial line dressing

- Use an aseptic non-touch technique and standard universal precautions.
- Carefully remove old dressing holding the cannula in place at all times
- Inspect site for complications
- Clean site with normal saline if indicated holding cannula at all times
- Apply new clear dressing (ensure stability of cannula)
- Depose of all equipment in line with waste policy
- Record procedure in nursing notes

Trouble shooting

Trouble shooting of an arterial line should be supervised and/or undertaken by a suitably trained and competent practitioner. Any suspect changes to the patient's condition should be reported to the medical staff and senior nursing team.

Dampened trace

There can be a few causes for a dampened trace; if dampened trace is shown on monitor the following actions should be taken.

- Assess child cardiovascular status, including pulse check, ECG waveform and non-invasive blood pressure, as the child may have no cardiac output or a low blood pressure.
- Check arterial line site, all connections and flush flow rate, to exclude back flow of blood.
- Check that appropriate scales is in use on monitor
- Check arterial line for clots, air or inadequate filling, change if necessary.
- Check that the blood can be easily aspirated and flushed at access port. Do not forcefully flush the catheter if resistance is high. There may be an

occlusion from a blood clot and this may cause trauma to vessel or release clot.

- Redress the cannula site and check for kinks or poor positioning of the cannula
- Reposition the child or the cannulated limb.

Abnormal readings

Abnormal high or low readings must be investigated as changes in arterial waveform frequently reflect pathological processes

- Assess child's cardiovascular status, including pulse, ECG waveform and non invasive blood pressure to ensure it is a monitoring problem and not a change in the child condition
- Ensure transducer is level with the right atrium
- Ensure appropriate low compliance giving set is used
- Recalibrate transducer as may have drifted

Bleeding puncture site

If bleeding occurs at the puncture site

- Apply firm pressure for 10 – 15 minutes to stop bleeding.
- Ensure the catheter is securely strapped or sutured
- Ensure cannulated limb is immobilized
- Check circulation on the extremities to ensure adequate circulation

Circulation compromised

If circulation is compromised distal to the puncture site:

- Observe circulation to the extremity, i.e. decreased pulse, blanched colour, cyanosis and cool skin, it may be due to an artery spasm.
- Maintain continuous flush
- Ensure the affected limb is kept warm to promote vasodilatation

The cannula must be removed if there is a sustained blanching to the limb, distal to the cannula.

No wave form

If there is no waveform visible on the monitor:

- check the system is set up and attached correctly
- check appropriate arterial scale is used on the monitor
- check the monitor display settings are correct
- try an alternative transducer lead and module to establish if equipment is faulty
- Contact ICU technicians to arrange repair if necessary.

If the cannula is not recording and not aspirating it should be removed and not left in situ

Electrical interference

If electrical interference is experienced:

- check transducer and cable for crack
- try an alternative lead and module
- Contact the ICU technicians or biomedical engineering to arrange repair if necessary.

Removal of arterial cannula

The arterial line should be removed when:

- limb circulation is compromised
- the cannula is misplaced/ not functioning
- It is no longer needed for monitoring and frequent blood sampling.
- There are signs of infection

Check the clotting levels before removal to prevent bleeding from the site. Some patients may require clotting factors before removal, such as fresh frozen plasma.

Informing the child and parents is good practice with any procedure, explain the reason why and what it entails.

Universal precautions and a non-touch technique must be adopted when removing an arterial line, i.e. gloves, apron and visor if indicated.

Equipment required

- Clean tray
- Non-sterile gloves
- Sterile gauze
- Surgical tape
- Sterile plaster
- Stitch cutter (if required)

Procedure

- Put on clean apron
- Wash hands
- Open all equipment onto clean tray
- Wash hands and put on non-sterile gloves
- Loosen dressing
- Cut suture (if present) and withdraw the line from the artery without applying pressure (as will cause pain if pressure is applied during removal)
- Using the sterile gauze, immediately apply pressure for up to 5 minutes or until bleeding has stopped, to reduce the risk of haematoma
- Apply sterile plaster or pressure dressing over the site
- Dispose of all equipment according to the waste policy
- Wash hands
- Observe site regularly for bleeding
- Record procedure in Childs notes.

The aim of this document is to:

- To maintain patients safety
- Ensure procedures are performed correctly
- Reduce the risk of infection
- To minimise the risk of complications.
- Accuracy of measurement
- To ensure adequate circulation is maintained
- To recognise and manage associated risks
- To avoid accidental dislodgment
- To meet the code of professional conduct

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