TITLE: ARTERIAL LINES – Adult/Pediatric
Patients greater than 30 Kg
A. Assisting with Insertion
   I. Preparing Pressure System
   II. Preparing Bedside Monitor
   III. Insertion
B. Maintenance
C. Dressing Change
D. Withdrawal of Blood
   I. Open System
   II. Closed (or reservoir) System
E. Removal of Peripheral and Femoral Arterial Lines

CATEGORY: RN – Special Nursing Procedure

PURPOSE

- To provide accurate invasive pressure monitoring.
- To maintain patency of arterial lines.
- To facilitate blood withdrawal for diagnostic and patient management purposes.
- To minimize risk of infection, damage, displacement and other complications associated with care and use of hemodynamic lines.

A. Assisting with Insertion

EQUIPMENT

1. Pressure module and cable
2. Single-channel pressure tubing kit with transducer (Blood conservation system per unit routine)
3. Pressure infusor bag
4. 500 mL bag NS
5. Patient body mount sticker
6. Arterial line insertion pack (Pasqua) – dressing set (RGH) - art.line kit in CCU
7. Sterile gloves
8. Masks
9. Personal protective equipment (PPE) as indicated
10. #20 or #22 gauge arterial catheter (or appropriate size for patient)
11. Local anaesthetic 1% or 2% xylocaine without epinephrine
12. 12 mL syringe
13. 25G needle
14. Chlorhexidine 2% aqueous solution
15. Disposable bed saver pad
16. Bath towel
17. Transparent semipermeable securement dressing – Tegaderm IV Advanced
18. 2” x 2” gauze
19. Appropriate size limb securing board (if desired)

**PROCEDURE**

**I. Preparing Pressure System**

1. Date and time flush solution.
2. Tighten all connections on pressure tubing and transducer set.
3. Spike saline flush bag with pressure tubing.
4. Prime tubing, including stopcock ports.
   
   If using the VAMP Closed Blood Sampling System:
   
   4.1 Push reservoir plunger to closed position.
   4.2 Ensure shut off valve is in open position (parallel to tubing), orient the kit so that reservoir inlet and outlet ports are in an upward vertical position. Hold sampling site above reservoir at a 45° angle.
   4.3 Flush system by pulling Snap-tab of pressure transducer system. Slowly fill and debubble reservoir, sample site and stopcocks in succession.
   4.4 Ensure removal of all air from system.

   **NOTE:** Replace all vented caps on ports of stopcocks with non-vented caps.

5. Apply pressure bag over IV solution.
6. Inflate pressure bag to 300 mmHg.

   **NOTE:** When pressure bag is inflated to 300 mmHg, pressure system will deliver 3 mL/hour and 4 mL/second when fast flush device is pulled.

**II. Preparing Bedside Monitor**

   **NOTE:** Measurement labels are stored in the Multimeasurement Module (MMS).

1. Select the designated ABP port on the MMS. In cases where there are two arterial lines in situ, designate the secondary arterial line as ART.

   **NOTE:** In case of label conflict or selecting additional labels please refer to IntelliVue Quick guide at bedside.

2. Attach pressure cable to appropriate port on MMS.
3. Attach open end of cable to pressure tubing transducer.

4. Zero transducer:
   4.1 Silence alarm.
   4.2 Close stopcock to patient line.
   4.3 Vent the transducer (i.e stopcock) to atmospheric pressure by removing the non-vented cap while maintaining asepsis.
   4.4 Press and hold “ZERO” smart key at the bottom of the main screen until audible “BEEP” is heard.
   4.5 Close stopcock to atmosphere.
   4.6 Return stopcock to monitoring position.

III. Insertion

NURSING ALERT:

- Insertion of an arterial line is the responsibility of a physician or respiratory therapist certified in this procedure.
- Common sites of arterial line insertion include radial, brachial, femoral or pedal arteries. If an artery is used in the leg, patient must be maintained on strict bed-rest.

1. Explain procedure to patient.

2. Place disposable bed saver pad under selected insertion site.

3. Don PPE as indicated.

4. Open the arterial line insertion pack, or dressing set.

5. Add Chlorhexidine 2% aqueous solution to sterile bowl.

6. Add syringe to sterile field.

7. Provide 25G needle as requested.

8. Provide Xylocaine solution as required.

9. Assist with positioning of selected limb as necessary.
   9.1 Place rolled towel under wrist, if extension is required.

10. Stabilize patient’s limb during insertion as required.

11. Assist with connecting arterial pressure line, once catheter is insitu.

12. Assist with catheter securement.
13. Use patient body mount sticker to secure transducer at level of phlebostatic axis (upper arm 4\textsuperscript{th} intercostal space).

**NOTE:** Depending on pressure tubing length for some set-ups, transducers are unable to be secured at phlebostatic axis. In these circumstances, secure transducer as close to insertion site as the tubing allows.

14. Evaluate arterial waveform.

14.1 Re-zero pressure line.
14.2 Adjust pressure scale as needed.
14.3 Adjust ABP alarm parameters as appropriate.
14.4 Ensure ABP monitoring alarm is activated.

B. Maintenance

**NURSING ALERT:**
- For purposes of monitoring, ensure ABP alarms remain on.
- If limb distal to arterial catheter ever shows signs of circulatory compromise, physician must be notified immediately and catheter must be removed.
- Patients with femoral arterial lines must remain on strict bed-rest unless ordered otherwise by physician. The HOB may be elevated 30\textdegree.

**PROCEDURE**

1. Ensure pressure bag is always maintained at 300 mmHg.

2. Ensure flush bag has greater than 50 mL solution to be absorbed.

3. Ensure transducer remains secured and leveled at recommended position of phlebostatic axis.

**NOTE:** Depending on pressure tubing length for some set-ups, transducers are unable to be secured at phlebostatic axis. In these circumstances, secure transducer as close to insertion site as tubing allows.

4. Ensure all tubing connections remain tight.

5. Ensure alarm parameters are individualized for the patient on an ongoing basis.

6. Assess limb distal to insertion site for color, sensation and movement every 4 hours.\(^{(2)}\)

7. Assess and change dressing as recommended.

8. Ensure correct position of extremity (i.e. armboard, restraint) for optimal waveform.

9. Zero transducer at beginning of each shift and after any interruption in monitoring.
10. Document a pressure waveform strip at beginning of each shift.

11. Perform a square wave test at beginning of each shift and prn (see Appendix A).\(^{(5,6)}\)

C. Dressing Change

**NOTE:** Transparent semipermeable dressing to be changed every 7 days or PRN. For people with sensitivities to chlorhexidine, alcohol followed by povidone-iodine is an accepted alternative.

**EQUIPMENT**

1. PPE
2. Sterile dressing set
3. Chlorhexidine 2% (may use aqueous or swabstick)
4. Steri-strips
5. Transparent semipermeable securement dressing – Tegaderm IV Advanced

**PROCEDURE**

1. Explain procedure to patient.

2. Don PPE.

3. Remove old dressing.

4. Observe insertion site for signs of infection.

4.1 Obtain swab for C&S, if indicated.

5. Prepare dressing set.

6. Cleanse a 5 cm radius around insertion site and up the catheter with cleansing solution.

7. Allow time for cleansing solution to dry.

8. Apply sterile transparent semipermeable dressing (Tegaderm IV Advanced) to insertion site.

**NOTE:** Use of alternate dressings, or additional material such as steri-strips/gauze to be supported with documentation in Nursing Notes. Gauze dressings to be changed every 2 days or PRN.

D. Withdrawal of Blood

EQUIPMENT

1. Appropriate type and sizes of blood tubes for lab tests required.
2. ABG kit (if necessary)
3. Blood conservation system Needleless Shielded Cannula
4. Vacutainer Luer Lok™ Access Device (Blood conservation system direct draw if appropriate)
5. Pediatric vacutainer adaptor as per blood conservation initiative.
6. Red top tube for discard
7. Alcohol swab
8. PPE
9. Disposable bed saver pad

PROCEDURE

NURSING ALERT:

- If a vacutainer is used to draw blood, use caution when discarding leur adapter, as rubber sheath is covering a needle.
- Collect specimens in the following order (as recommended by lab): blue top, red or yellow top (SST), purple top, grey top.
  - If blood cultures are required, they must be drawn by syringe method and transferred into blood culture medium vials. Media within blood culture tubes must never come into contact with patient's circulation. (See Appendix B for syringe method)

I. Open System

1. Explain procedure to patient.
2. Insert Vacutainer Luer Lok™ Access Device or pediatric vacutainer adaptor into vacutainer holder.
3. Don PPE.
4. Place bed saver pad beneath stopcock.
5. Suspend alarms on monitor.
6. Remove cap from stopcock, and place sterile side up on clean surface.
   - 6.1 If clave arterial adapter is in place, cleanse port with alcohol swab.
7. Insert blunt end cannula of vacutainer into stopcock/clave port.
8. Turn stopcock off to transducer, open from patient to vacutainer.
9. Insert 10 mL red top vacutainer and fill to one half for discard.

10. Replace red vacutainer tube with appropriate vacutainer collection tubes.

11. Turn stopcock off to vacutainer port.

12. Procure ABG’s:
   
   12.1 Use syringe from ABG kit and set plunger to desired sample volume of 1 mL.
   12.2 Attach syringe and turn stopcock off to transducer.
   12.3 Allow syringe to fill with blood.
   12.4 Turn stopcock off to vacutainer port.
   12.5 Remove syringe from stopcock.
   12.6 Eject any air bubbles from ABG syringe.
   12.7 Cap with rubber stopper from package.
   12.8 Label specimen.
   12.9 Transport specimen to lab.

13. Reattach vacutainer Luer Lok™ Access Device (if removed) and red top vacutainer previously used for discard.

14. Turn stopcock off to patient (open from transducer to vacutainer).

15. Pull fast flush device on pressure tubing to flush system into vacutainer.

16. Turn stopcock off to vacutainer (open from transducer to patient).

17. Pull fast flush device to clear pressure tubing of blood.

18. Remove vacutainer system.

19. Return sterile cap to stopcock, if applicable.

20. Ensure alarms on monitor are no longer in suspended mode.

21. Label blood tubes with patient name and HIN#.

   **NOTE:** Lactate specimens in grey top tube must be placed on ice.
   Cross Match blood tubes must include patient’s date of birth.

22. Transport specimens to lab.
II. Closed (or reservoir) System (Blood Conservation System)


PROCEDURE

1. Explain procedure to patient.

2. Don PPE.

3. Suspend alarms on monitor.

4. Turn stopcock off to transducer.

5. Squeeze the reservoir plunger flexures together gently.

6. Pull up on the reservoir plunger smoothly and evenly, until the plunger stops and the reservoir has reached its full capacity.

7. Close the shut-off valve by turning the handle perpendicular to the tubing.

8. Swab the sampling site with alcohol.

9. Attach the blood conservation system direct draw vacutainer with the pediatric vacutainer adaptor to the sampling site.

10. Fill required blood tubes.

11. Remove direct draw vacutainer by pulling it straight out.

12. Procure ABG’s:

   12.1 Use syringe from ABG kit and set plunger to desired sample volume of 1 mL.
   12.2 Remove needle from syringe and attach VAMP Needleless Shielded Cannula.
   12.3 Insert cannula into sampling site.
HEALTH SERVICES
CODE  A.2

12.4 Allow syringe to fill to 1 mL.
12.5 Remove syringe from sampling site.
12.6 Eject any air bubbles from ABG syringe.
12.7 Remove shielded cannula and cap syringe with rubber stopper from package.
12.8 Label specimen.
12.9 Transport specimen to lab.

13. Open shut-off valve.

14. Depress reservoir plunger, slowly and evenly, until the flexures lock in place and blood is reinfused.

15. Open stopcock at transducer.

16. Pull fast flush device to clear pressure tubing of blood.

17. Ensure alarms on monitor are no longer in suspended mode.

18. Label blood tubes with patient name and HIN#.

NOTE: Lactate specimens in grey top tube must be placed on ice.
Cross Match blood tubes must include patient’s date of birth.

19. Transport specimens to lab.

E. Removal of Peripheral and Femoral Arterial Lines

EQUIPMENT

1. Sterile gauze 4 – 2 x 2
2. Transparent dressing
3. Chlorhexidine 2% swabs – 2
4. Non-sterile gloves
5. Sterile gloves
6. PPE

PROCEDURE

1. Verify physician’s order.

2. Check patient’s INR/PTT, notify physician if results are prolonged.

3. Verify patient using two patient-identifiers.

4. Explain procedure to patient.

5. Perform hand hygiene.

6. Don appropriate PPE.
7. Release pressure on flush bag.
8. Turn stopcock off to patient.
9. Disconnect cable from transducer and remove cable from MMS.
10. Press silence on monitor to remove pressure waveform from screen.
11. Remove tape and dressing over arterial site carefully.
12. Inspect site and swab for C&S if signs of infection present.
13. Open Chlorhexidine 2% swab(s).
15. Apply sterile gloves.
16. Cleanse site with Chlorhexidine 2% swab(s).
17. Place 2 x 2 gauze(s) over catheter.
18. Apply firm pressure while removing catheter.
19. Maintain manual pressure for 5-10 minutes as indicated below.

19.1 Peripheral Site:
19.1.1 Apply direct manual pressure to insertion site.
19.1.2 Check site after 5 minutes, if oozing or bleeding persists, continue to apply manual pressure for 5 more minutes before checking again.
19.1.3 Continue with manual pressure for a minimum of 5 minutes after evidence of bleeding from site has stopped.

19.2 Femoral Site:
19.2.1 Apply manual pressure 1 – 2cm proximal to insertion site.
19.2.2 Check site after 10 minutes, if oozing or bleeding persists, continue to apply manual pressure for 5 more minutes before checking again.
19.2.3 Continue with manual pressure for a minimum of 5 minutes after evidence of bleeding from site has stopped.

NOTE: Prolonged and direct pressure is required to stop bleeding from an artery. Inadequate hemostasis can lead to bleeding, and hematomas may impair circulation distal to puncture site, as well as cause discomfort for patient.
20. Apply 2x2 gauze and transparent dressing over site when bleeding has stopped.

**NURSING ALERT:**
- Use of pressure dressings are not recommended.
- Pressure dressings do not provide adequate compression, can increase patient discomfort and delay detection of bleeding.

21. Assess site for bleeding and evaluate distal extremity for color, warmth, mobility sensation as indicated below.

21.1 **Peripheral Site:**
   21.1.1 Assess site q15min x 1 hour, then PRN
   21.1.2 Apply direct pressure to site if bleeding noted at any time, as per step 19.

21.2 **Femoral Site:**
   21.2.1 Assess site q 15min x 1hour, q 30min x 1hour, q 1hour x 2hours, then PRN
   21.2.2 Apply direct pressure to site if bleeding noted at any time, as per step 19.

22. Minimize limb activity for at least one hour post removal.

22.1 **Femoral Lines:**
   22.1.1 Immobilize leg from hip flexion for a minimum of two hours.
   22.1.2 HOB may be elevated up to 30°.

23. Apply immediate manual pressure for persistent bleeding and hematoma formation.

24. Report persistent bleeding, loss of pulses, decreased CWMS and hematoma formation to physician promptly.

**NOTE:** Remove dressing from site within 24 – 48 hours.

25. Dispose of the tubing and flush bag.

REFERENCES


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Date: March 2015

Approved by: Regina Qu’Appelle Health Region Health Services Nursing Procedure Committee

June 3, 2015

Approved: June 3, 2015
**Square Wave Test**

1. Activate fast flush device.
2. Hold flush device open for less than 1 – 2 seconds.
3. Quickly release flush device.
4. Note square wave pattern on monitor.

**Square wave test configuration**

![Square wave test configuration](image)

**Fig 16-56**

Square wave test.

(A) Optimally damped system: Activation of the fast flush device generates a sharp vertical upstroke, horizontal line, and straight vertical downstroke ending with one or two oscillations (minimal ringing) and quick return to the baseline.

(B) Overdamped system: Activation of the fast flush device generates a slurred upstroke and downstroke with no oscillations above or below the baseline. Causes of an overdamped system include system leaks, blood clots, or air bubbles in the tubing or transducer.

(C) Underdamped system: Activation of the fast flush device generates a sharp vertical upstroke and downstroke and ends with numerous oscillations (more than three) above and below the baseline. Usually caused by small air bubbles in the system. From: Darovic GO: Hemodynamic Monitoring: Invasive and Noninvasive Clinical Application, p 161. Philadelphia, W.B. Saunders, 1995.

Blood Withdrawal from Arterial Line Using Syringe

NURSING ALERT:
- If blood cultures are required, they must be drawn by syringe method and transferred into blood culture medium vials. The media within the blood culture tubes must never come into contact with the patient’s circulation.

1. Withdraw a minimum 3 mL waste via syringe.
2. Aspirate 20 mL blood using a 20mL syringe.
3. Transfer blood to sample tubes by attaching blood transfer device (double female connector) to blood filled syringe.
4. Attach other end of double female connector to Angel Wing® blood collection device.
5. Insert Aerobic blood culture tube first, add 8 – 10 mLs of blood, and remove vial.
6. Insert Anaerobic blood culture tube next, add 8 – 10 mLs of blood, and remove vial.
7. Discard all sharps and biohazard materials appropriately.
8. Label Culture Vials with appropriate identifications, and send samples to lab with appropriate requisitions.

## IV Tubing Changes

<table>
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<tr>
<th>IV</th>
<th>Bag change</th>
<th>Tubing Change Time</th>
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<tbody>
<tr>
<td>Plain IV solution (no additives) this includes pressure tubing</td>
<td>Every 96 hours</td>
<td>Every 96 hours</td>
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<tr>
<td>IV solution with additives: manufacturer or pharmacy mixed</td>
<td>Every 96 hours</td>
<td>Every 96 hours</td>
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<tr>
<td>IV solution with additives: nurse mixed</td>
<td>Every 24 hours</td>
<td>Every 96 hours</td>
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<tr>
<td>IV solution with Lipids</td>
<td>Every 24 hours</td>
<td>Every 24 hours</td>
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<tr>
<td>Propofol</td>
<td>Every 12 hours</td>
<td>Every 12 hours</td>
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<tr>
<td>Blood products</td>
<td>Per orders</td>
<td>Every 4 units or 24 hrs, whichever occurs first.</td>
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<tr>
<td>Intermittent medications</td>
<td>___</td>
<td>Every 24 hours</td>
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