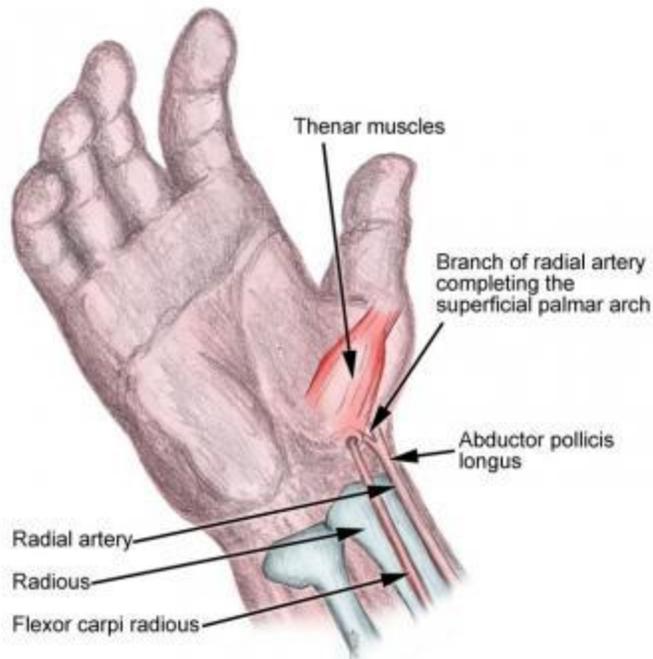


# Arterial Line

An arterial line is a thin catheter inserted into an artery. Arterial line placement is a common procedure in various critical care settings. It is most commonly used in intensive care medicine and anesthesia to monitor blood pressure directly and in real time (rather than by intermittent and indirect measurement, like a blood pressure cuff) and to obtain samples for arterial blood gas analysis. There are specific insertion sites, trained personnel and procedures for arterial lines. There are also specific techniques for drawing a blood sample from an A-Line or arterial line.

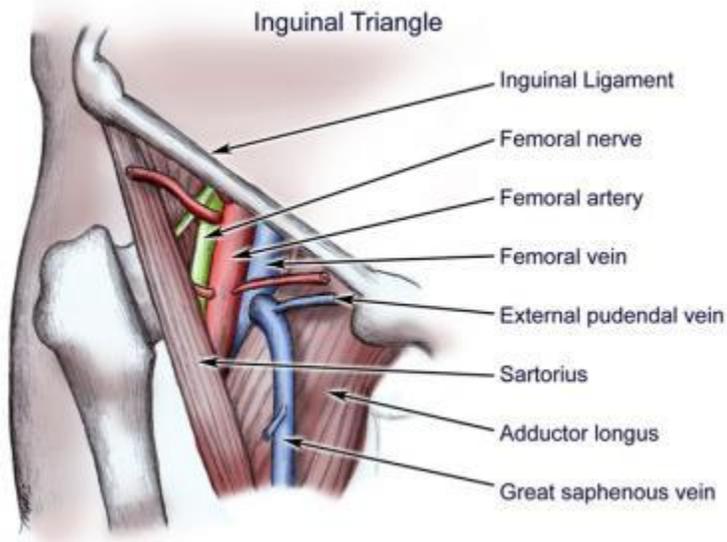
An arterial line is usually inserted into the radial artery in the wrist, but can also be inserted into the brachial artery at the elbow, into the femoral artery in the groin, into the dorsalis pedis artery in the foot, or into the ulnar artery in the wrist. In both adults and children, the most common site of cannulation is the radial artery, primarily because of the superficial nature of the vessel and the ease with which the site can be maintained. Additional advantages of radial artery cannulation include the consistency of the anatomy and the low rate of complications.



After the radial artery, the femoral artery is the second most common site for arterial cannulation. One advantage of femoral artery cannulation is that the vessel is larger than the radial artery and has stronger pulsation. Additional advantages include decreased risk of thrombosis and of accidental catheter removal, though the overall complication rate remains comparable.

There has been considerable debate over whether radial or femoral arterial line placement more accurately measures blood pressure and mean arterial pressure, however, both approaches seem to perform well for this function. In determining the need for and optimal location of arterial line placement, one must consider the risk and benefits of the procedure for each patient. A golden rule is that there has to be collateral circulation to the area affected by the chosen

artery, so that peripheral circulation is maintained by another artery even if circulation is disturbed in the cannulated artery.



## Radial Art Line



**Click the Video link above**

There are multiple people that perform arterial line insertions. Cardiologists/cardiac surgeons, critical care doctors, anesthesiologists, emergency doctors, thoracic surgeons, registered nurses specially trained in arterial lines and certified nurse anesthetists may all insert arterial lines.

When placing an arterial line, make sure to follow these steps to successfully facilitate placement of an arterial line:

1. Always position the patient appropriately and feel arterial pulsation before initiating arterial line placement
2. Before starting the procedure, flush the needle introducer with heparinized flush to facilitate flashback of blood up to the needle hub upon entry into the artery
3. Puncture the radial artery in a slight lateral-to-medial direction; this allows the artery to be stabilized against the flexor carpi radialis tendon
4. After arterial puncture or decannulation, maintain pressure over the puncture site for at least 5 minutes (or possibly longer if the patient is in a hypocoagulable state)
5. Make a small skin incision at the site of needle puncture to allow easier passage of the catheter through the skin and help prevent catheter kinking during advancement
6. When using a catheter-over-needle technique, be sure to advance the needle 2 mm after flash to ensure catheter placement inside the lumen

7. When using a Seldinger technique, do not dilate the artery; to minimize bleeding and vessel injury, dilate only the soft tissue tract
8. If the guide wire cannot be passed into the artery, try rotating the needle 90-180° in an attempt to eliminate an intimal flap blocking passage of the wire
9. To avoid creating false passages, refrain from forcing further advancement if passage of a guidewire or catheter meets with resistance
10. When it proves difficult to advance the catheter into the lumen, consider the “liquid stylet” method; fill a 10-mL syringe with 5 mL of sterile normal saline, attach it to the catheter hub, aspirate 1-2 mL of blood into the syringe, and then slowly inject the syringe contents into the vessel as the catheter is advanced behind the fluid wave
11. If several attempts at cannulation fail, the artery may spasm, making further attempts more difficult; if this occurs, allow the artery to recover for a short time before reattempting cannulation; subcutaneous infiltration of lidocaine or similar anesthetic around the puncture site may reduce vessel spasm
12. Consider adding papaverine 30 mg/250 mL to the arterial line fluid, this may prolong the patency of peripheral arterial catheters in children and neonates
13. Regularly inspect the area for signs of ischemia, and remove the catheter at the first signs of circulatory compromise or clot formation; do not flush the catheter in an attempt to remove clots

14. To reduce the complication rate, remove the catheter as soon as it is no longer necessary

15. Arterial lines are generally not used to administer medication, since many injectable drugs may lead to serious tissue damage and even require amputation of the limb if administered into an artery rather than a vein. Intra-arterial BP management permits the rapid recognition of BP changes that is vital for patients on continuous infusions of vasoactive drugs. Arterial cannulation also allows repeated arterial blood gas samples to be drawn without injury to the patient. There are multiple indications for arterial line placement, such as...

- Cardiovascular conditions including severe uncontrolled hypertension, heart failure, and cardiovascular arrest.
- Labile blood pressure (hypotension) including hypotension due to severe bleeding, sepsis and shock.
- Major surgery including open-heart surgery, chest surgery, brain surgery, organ transplants, trauma surgery, and certain abdominal surgeries.
- Coma including coma due to stroke and head injury
- Drug overdose or poisoning including ingestion of drugs or exposure to toxins, such as organophosphates including nerve gas

- Anticipation of hemodynamic instability
- Titration of vasoactive drugs
- Frequent blood sampling
- Respiratory failure including respiratory failure due to severe asthma or pulmonary edema
- Morbid obesity (unable to fit an appropriately sized NIBP cuff).

Calibrating (zeroing) the arterial line has specific steps. First, ensure the transducer pressure tubing and flush solution are correctly assembled and free of air bubbles. Next, place transducer at level of the right atrium, make sure it is off to patient (open to air), press zero – this sets atmospheric pressure as zero reference point and whenever patient position is altered the transducer height should be altered. There are multiple conditions that must be met to ensure accuracy. First, make sure cannula is properly placed within the lumen of an unobstructed artery (i.e. No spasm, thrombus, atheroma proximal to cannula). Make sure cannula is not kinked or obstructed, cannula connected by short, rigid, wide-bore tubing to the transducer, no air bubbles in tubing or transducer, interface from fluid to transducer accurately transmits deflections, transducer has adequate frequency response (natural frequency >100Hz, transducer is leveled and zeroed to desired point (i.e. left atrium), no zero drift and monitor calibrated accurately.

There are multiple common sources of error. Look for bubbles in catheter-transducer system – decreased resonant

frequency, clotting in arterial catheter, elastic walls causes increased damping, and cannula won't flush due to kinked or clotted line.

An arterial line can measure much more than blood pressure. Arterial lines can measure pulse rate and rhythm, effects of dysrhythmias on perfusion, ECG lead disconnection, continuous cardiac output using pulse contour analysis, specific wave form morphologies that might be diagnostic, pulse pressure variation and steeper upstroke of pulse pressure.

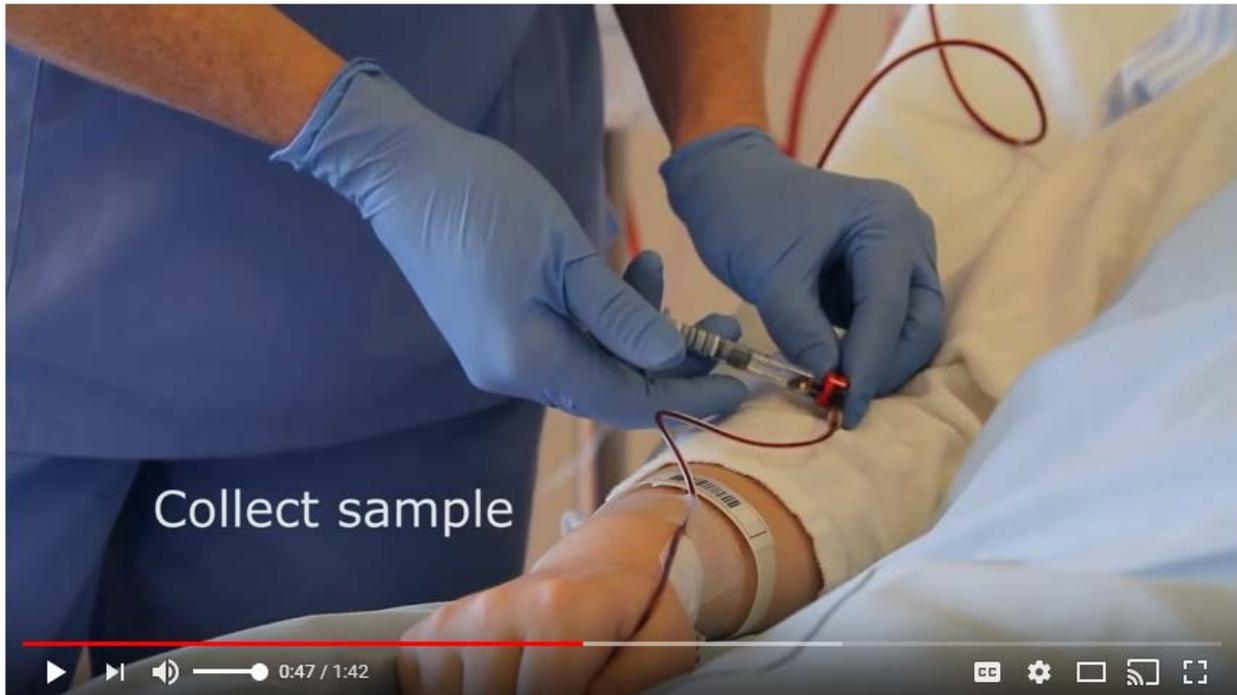
There are multiple complications associated with arterial lines. Insertion is often painful; an anesthetic such as lidocaine can be used to make the insertion more tolerable and to help prevent vasospasm, thereby making insertion of the arterial line somewhat easier. Aside from pain, other complications include, thrombosis and distal ischaemia, infection, increased diagnostic blood loss and anemia, retrograde air embolism, inadvertent drug/air injection, haematoma, retroperitoneal haematoma (femoral), bowel obstruction (femoral), vessel damage may lead to stricture and prevent future AV fistula formation for haemodialysis and pseudo-aneurysm.

Zeroing the arterial line helps to give the most accurate reading possible. First, close off the line to the patient (so that no air goes inside while zeroing) and then open the line up to air. This allows the pressure reading to be set at atmospheric pressure as your reference point for monitoring blood pressure or central venous pressure. Having an accurate atmospheric

pressure helps to ensure the accuracy of your reading. Let's look at steps for zeroing....

- The spot where the zeroing takes place is at the transducer. Start by turning the stopcock (white part of the transducer) off to the patient. This blocks air from getting into the patient while zeroing.
- Take off the cap on the transducer (the clear cap behind the stop cock). Some of these already have holes in them which would mean that you don't have to take it off. Make sure that you keep the cap end sterile. You don't want to introduce any kind of bacteria into the pressure line.
- Press the "zero" button on your monitor. Wait for it to zero the line. This typically takes about five seconds.
- Place the clear cap back on the transducer.
- Turn the stopcock back upwards (this would be turning it 90 degrees to the right). This allows the pressure line to actually monitor the pressure.

## How to draw blood sample from an arterial line



### Click the video link above

1. Use aseptic technique
2. Remove sterile cap from unused port of the most proximal of stopcocks to the insertion site. (Place cap in sterile gauze).
3. Attach sterile syringe (3ml).
4. Turn stopcock off to flush solution and on to patient.
5. Gently withdraw 3 ml of blood (to clear line of heparin solution and possible clots).
6. Turn stopcock off to all three ports.
7. Remove syringe and discard.

8. Place a second sterile syringe on stopcock (should be heparinized if for ABG analysis). To heparinize a syringe (many syringes are pre-heparinized):
  - a. Use aseptic technique
  - b. Withdraw 0.5 ml of 1:1,000 Na heparin with a sterile syringe.
  - c. Coat inside of syringe with heparin.
  - d. Expel excess heparin.
9. Turn stopcock on to patient.
10. Withdraw desired amount of blood.
11. Turn stopcock off to sample port on to patient.
12. Remove syringe (if for ABBG analysis: remove air bubbles, cap, rotate to mix with heparin, label and place on ice).
13. Flush system for 1-3 seconds.
14. Turn stopcock off to patient and on to sample port.
15. Flush sample port (collect fluid with a sterile gauze).
16. Turn stopcock off to sample port and back on to patient.
17. Replace sterile cap.
18. Resume IV flow.

Note: Newer closed systems allow collection without opening to the air.

## **Removing Arterial Line**

When removing the arterial line, gather necessary removal equipment. You will need non-sterile gloves, sterile gauze, surgical tape, small sterile plaster (if required), stitch

cutter. Loosen all dressings, cut retaining suture if present and withdraw the line from the artery without applying pressure. Using the sterile gauze immediately apply pressure for up to five minutes or until bleeding has stopped. Make sure to observe the site regularly for bleeding every five minutes for the first minutes, then every hour. Insure that the patient does not have any numbness or tingling in the area.

Overall, arterial line placement is considered a safe procedure, with a rate of major complications that is below 1%. It is not entirely without risks, however, and it requires appropriate knowledge of the anatomy and procedural skills.

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