

Science Education Collection

Arterial Line Placement

URL: <https://www.jove.com/science-education/10178>

Overview

Source: Sharon Bord, MD, Department of Emergency Medicine, The Johns Hopkins University School of Medicine, Maryland, USA

When monitoring patients, it is important to obtain values that are accurate and reliable. Blood pressure monitoring is one of the essential vital signs, and for a majority of patients, measuring it utilizing non-invasive techniques provides accurate values. However, there are situations in which the blood pressure requires more exact, specific, and reliable measurements. This can be achieved by intra-arterial blood pressure monitoring and requires arterial line placement. Arterial line placement refers to the insertion of a catheter, which is able to transduce blood pressure, into one of the major arteries (e.g., radial or femoral artery). Patients who potentially need arterial line placement include those with extreme low (such as in sepsis or cardiogenic shock) or high (as in cerebrovascular accident or hypertensive emergency) blood pressure measurements. Many of these patients are placed on vasoactive medications to either increase or decrease blood pressure. When the goal is to decrease a patient's blood pressure, it must be done gradually, which further necessitates close blood pressure monitoring. Arterial line placement is also ideal for patients who require frequent arterial blood gas monitoring.

Procedure

1. Preparation for the procedure

1. Obtain the necessary supplies. This includes:
 1. Antiseptic skin prep pads, such as chlorhexidine pads
 2. A syringe (lidocaine 1%) with a needle attached
 3. Arterial line introducer kit. There are two different types of kits: an over-the-needle catheter kit and a kit with a guide wire
 4. Proper suture material (generally #0 silk) with a needle driver, pickups, and iris scissors
 5. Tape for patient positioning
 6. Gauze
 7. Tegaderm or sterile dressing to further secure the line
 8. An arm board (only some patients require an arm board)
2. Don personal protective equipment (this includes appropriately sized sterile gloves and a mask with an attached face shield). It is imperative to keep the eyes shielded from possible exposure.
3. Make sure the arterial line setup is attached to the monitor correctly. This is generally set up by nurses, so this procedure is not addressed in this video. It is important for the nurses to have this prepared for hook-up, once the line is inserted.

2. Assess for contraindications to the procedure

1. Note if cellulitis or a severe burn appears at the insertion site, as these are contraindications to arterial line placement.
2. Assess for adequate collateral blood flow to the hand. This is done via the modified Allen's test.
 1. Ask the patient to make a fist. Then, occlude the patient's ulnar and radial arteries with both thumbs.
 2. As the patient releases the fist, the hand should be pale.
 3. Release the pressure on the ulnar artery. In a negative test, the hand turns pink, which indicates that the ulnar artery is functioning properly. Therefore, one can proceed with the arterial line placement in the radial artery of that arm.

3. Patient Positioning

Patient positioning is a key part of the procedure. The two most common sites for arterial line placement are the radial and femoral arteries. The radial artery is most commonly used due to its superficial location.

1. Radial Artery
 1. Place the patient's arm on a flat surface in supine position, with the wrist adequately exposed.
 2. Place the patient's hand in dorsiflexion and support it in this position with a gauze roll under the hand's dorsal aspect. This brings the radial artery closer to the skin surface to aid in cannulation.
 3. To maintain the patient's hand in the dorsiflexion, tape the hand with the gauze roll. Alternatively, the hand can be firmly held in this position, although it is not as secure.
2. Femoral Artery
 1. Have the patient in the supine position with the leg slightly abducted and as straight as possible. The femoral artery is a larger vessel, and placement here might be less challenging logistically.

4. Line Placement

There are two different techniques commonly utilized: "over the wire" and "over the needle."

1. Prior to line insertion, prep the insertion area with a chlorhexidine swab and allow the area to dry.
2. Begin both techniques by locating the artery by palpation.
 1. Locate the radial artery (approximately 1-2 cm proximal to the wrist) by feeling for the pulse with your non-dominant hand.
 2. Palpate the femoral artery about midway between the anterior superior iliac spine and the pubic symphysis, below the inguinal ligament. When feeling for the femoral pulse, recall the anatomy - from lateral to medial, the structures are as follows - nerve, artery, vein, and lymphatics.
3. To prevent discomfort from this procedure, anesthetize the insertion site by an intradermal injection of a 1-2 cc of lidocaine 1%.
4. Using your dominant hand, insert the needle at a 30-45° angle where the pulse has been felt.
5. When advancing the needle, look at the hub for a "flash" of blood. It is important to pay attention to the first flash, as the radial vessel is small, and a flash can be easily missed, which may cause one to go through the vessel. The blood should be bright red in appearance, as opposed to the darker colored blood from a vein.
6. Once the flash is seen, advance the needle a few more millimeters.
7. Over-the-wire Technique
 1. Advance the wire gently into the vessel, while removing the needle. The wire should not meet much resistance and should easily thread.
 2. If experiencing difficulty with threading the wire, gradually rotate the needle tip and attempt the wire placement again.
 3. After the wire is inserted, advance the catheter over the wire and remove the wire. Be sure to never let go of the wire during the procedure.
8. Over-the-needle Technique
 1. If using the needle technique, when the flash is seen, advance the needle a few millimeters more and then gradually advance the catheter as the needle angle is reduced to approximately 10°. The catheter should advance easily into the vessel.
9. When removing either the needle or the wire, be careful to hold pressure on the proximal portion of the catheter. If the catheter is in the proper location, there should be pulsatile blood flow from the catheter.
10. Promptly connect the hub of the catheter to the arterial line setup. At this time, blood pressure monitoring can begin.
11. Secure the line with suture and place a sterile dressing over the line.
12. Discard the sharps appropriately.
13. Assess perfusion to the distal extremity by feeling for a pulse distal to where the line is inserted or by assessing capillary refill. If the line is inserted into the radial artery in the wrist, assess for capillary refill in the hand. If inserted into the femoral vessel, a distal pulse and capillary refill in the foot should be evaluated.

Summary

Placement of an arterial line is a core procedure when caring for critically ill patients. It is important to note that the procedure might not be successful on the initial attempt. If multiple attempts are made for placement in the same vessel, spasm may develop. In this situation, an alternative site should be identified for arterial access. Arterial line placement provides accurate and timely blood pressure monitoring and affords a clinician with the ability to closely titrate medications and pressors.