

Subclavian Central Venous Catheter Placement

Erin Morris, Ariel Santos and Richard Davis

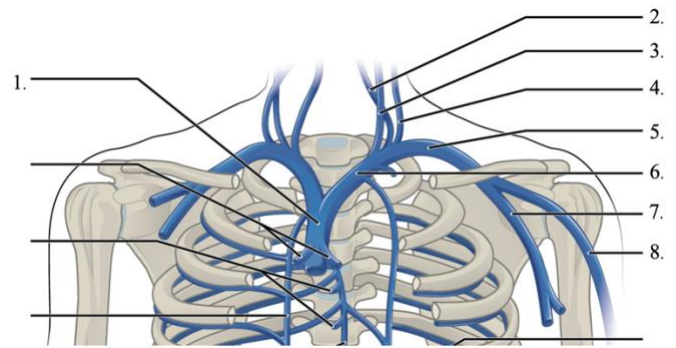
Introduction:

Subclavian catheters can be temporary or permanent, non-tunneled or tunneled, or connected to a port under the skin. Tunneling is used only when the line is needed long-term, as for dialysis or chemotherapy administration. The catheter can be single, double or triple lumen depending on the need of the patient but taking into account that infection rate increase with the number of lumens. The most common line used in the critically ill surgical patient is a non-tunneled triple lumen catheter, or a “Cordis” large bore catheter which allows large volume resuscitation.

Indications for a subclavian central line include inadequate peripheral venous access, need for large volume resuscitation or advanced hemodynamic monitoring, need for central venous access for hemodialysis, certain medications, or parenteral nutrition, cardiac access for transvenous pacing and extracorporeal membrane oxygenation.

Contraindications for placement of a central line include abnormal anatomy and clotted vessel. Practice extreme caution in the presence of coagulopathy and /or thrombocytopenia. A previous clavicle fracture should warrant caution: it may be difficult or impossible to safely pass the needle beneath the clavicle as described here.

The subclavian vein is a continuation of the axillary vein. At the lateral border of the first rib, the axillary vein becomes the subclavian vein where it passes over the rib. The axillary artery, which becomes the subclavian artery in the same location, lies directly posterior to the vein. The subclavian vein continues proximally beneath the clavicle heading towards the sternal notch until it joins the internal jugular vein and becomes the brachiocephalic vein, also called the innominate vein.



Veins of the upper extremities, upper chest, and neck. 1. Superior vena cava. 2. Vertebral vein. 3. Internal Jugular vein. 4. External Jugular vein. 5. Subclavian vein. 6. Innominate, or Brachiocephalic vein. 7. Brachial vein. 8. Cephalic vein. It is possible to achieve central venous access through any of these veins; the most commonly used are the Internal Jugular (described elsewhere in this Manual,)the Subclavian, and the Cephalic (used for “Midline” or Peripherally Inserted Central Catheters (PICC).)

Materials:

- Sterile Drape
- Local anesthetic
- 10 mL Saline Flushes
- 10 mL syringe
- Retractable scalpel
- Dilator
- Guidewire
- Suture and Needle
- Central Line Catheter
- Catheter Caps
- Dressing



A typical “central line set” will contain most of the items listed above. Variably included items include local anesthetic, suture and needle, dressing, and saline for flushing the catheter. The surgeon is encouraged to make sure these items are present on the sterile field before beginning, rather than asking for them in the middle of the procedure.

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Steps:

1. Assure that the platelets and coagulation profile have been measured recently and are within normal limits. Check for a history of previous central venous catheterization or known thrombosis of superficial or deep veins in the area.
2. If available, visualize anatomy using ultrasound. This should always be done before and during Internal Jugular central line placement, as the vein will be cannulated under ultrasound guidance (described elsewhere in this Manual.) For subclavian access, the ultrasound probe is placed parallel to the clavicle at the point where the artery and vein pass underneath it.



As shown here, the subclavian veins can be assessed with a sterile probe cover on the ultrasound. It is also acceptable to assess the veins before preparing and draping the patient, as the ultrasound is used for assessment only, not access, in this procedure.

3. Prepare your workstation including caps, saline, lidocaine, sterile gown and gloves. Flush all the ports with sterile saline solution. Proper preparation is important here, as your hands will be committed during the procedure, and it will be difficult to remove caps or connect items together. Full body draping and wearing gown, mask and gloves have been shown to reduce incidence of catheter-related infection.
4. Prepare the skin widely, including both the subclavian and internal jugular access sites on

both sides, in case the line cannot be placed in the originally intended site. Apply sterile drapes.

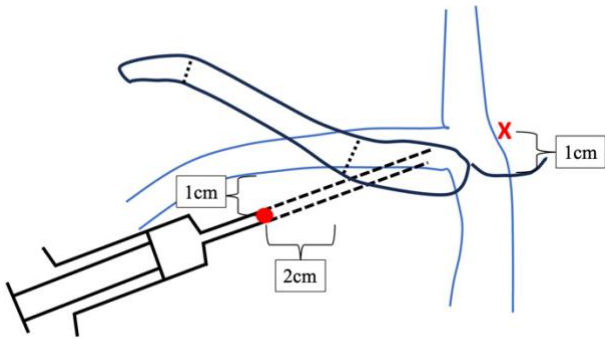
5. Inject the skin site with local anesthesia. Try to pass the needle under the clavicle and numb this area as well, following the same path that you will take while inserting the catheter.
6. Place the patient on reverse Trendelenburg position. If the patient is awake, communicate the steps of the procedure.
7. Palpate the clavicle and place one non-dominant hand at the top of the clavicle. Place the index finger on the sternal notch and the thumb at the angle of the clavicle, approximately two-thirds of the way lateral from the sternal notch. Utilizing the syringe and needle, puncture and advance the needle through the skin between the thumb and index finger, angling towards the sternal notch using the dominant hand.



With the index finger of the non-dominant hand palpating the suprasternal notch, pass the needle under the clavicle at the place where it angulates in a cranial direction. Avoid lifting your hand to “help” the needle pass under the clavicle at an angle. Instead, keep the needle horizontal and depress the entire needle and syringe towards the floor until the tip passes underneath the clavicle.

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Landmarks for successful subclavian vein access. The clavicle has three parts, as shown in this illustration. Find the junction between the medial 1/3, which extends transversely, and the middle 1/3, which extends obliquely as shown. Puncture the skin in a location 2cm lateral and 1cm inferior to this junction. Advance the needle under the clavicle, keeping it horizontal, and aiming towards your fingertip, a point 1cm above the suprasternal notch.

8. Aspirate gently as you advance. Stop once a “flash” of dark, non-pulsatile blood is visualized in the syringe. If you do not obtain blood, withdraw the needle slowly while aspirating; sometimes the tip of the needle has punctured both walls of the vein simultaneously. As you withdraw it, the tip will pass through the lumen and you may get a “flash” of blood at this time.



When the tip of the needle is inside the vein, dark red blood will suddenly appear in the syringe in a “flash.” Stop inserting or withdrawing the needle at this point.

If you are unable to obtain blood initially, remove the needle fully from the track before changing its direction. The tip of the needle is sharp, it may

damage surrounding structures and vessel walls if it is moved while inside tissue.

9. Grasp the hub of the needle with your non-dominant hand and steady it against the chest wall. With your dominant hand, gently remove the syringe from the needle, making sure that the needle does not move at all. Blood should drip in a non-pulsatile fashion after the syringe is removed from the needle.
10. Advance the guidewire slowly through the needle. There should be no resistance. If resistance encountered immediately as the wire exits the needle, stop and re-evaluate subclavian vein access; most likely your needle tip is no longer in the vein. If your guidewire advances for 20cm or so and then has resistance, it may have passed into the contralateral internal jugular or subclavian vein. Holding the needle hub steady with your non-dominant hand, withdraw the guidewire about 15cm and reinsert it. You may also try rotating the wire 180 degrees after withdrawing it and before reinserting it.



Inserting the guidewire through the needle. The non-dominant hand grasps the hub of the needle and steadies itself against the patient's body to avoid any movement. This avoids dislodgement of the tip of the catheter from within the vein, or damage to the vein by the sharp end of the needle.

11. Once guidewire is in place, slide needle out of the patient, holding and maintaining control of the guidewire at all times.
12. Utilize the small retractable scalpel to increase the size of the insertion site with the blade facing away from the wire.

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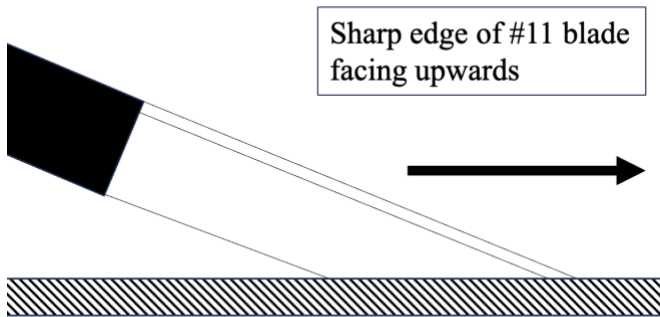
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The scalpel blade is advanced along the guidewire to cut the skin as shown below.



The guidewire is passed through the tip of the dilator



The #11 blade is held with the sharp edge facing upwards, and the dull edge lying on the guidewire. It is advanced in the direction shown by the arrow, cutting the skin just enough to allow passage of the dilator(s) and then the catheter itself.



Advance the dilator along the guidewire's tract, while steadying the guidewire itself with the non-dominant hand. The guidewire should move freely within the lumen of the dilator as it is being advanced, to assure that the dilator does not deviate from the tract that the guidewire passes through.

13. Advance the dilator over the guidewire, mild resistance is to be expected however the dilator should still slide smoothly over the guide wire. The guidewire must always move freely within the dilator as it advances; if it does not, possibly your dilator is following a "false passage" instead of the path of the guidewire. Always have full control of the guidewire and be holding some part of it throughout this process. After you remove the dilator, place your gloved finger at the insertion site to minimize bleeding. If you encounter resistance at the skin, your skin incision is not big enough, or not centered over the wire. If you encounter resistance below the skin, verify that you have not deviated from the guidewire's tract by trying to gently slide the guidewire within the dilator.

14. Advance the catheter over the guide wire up to the desired length which is typically at least 10 cm. Remove the guidewire.

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Advance the catheter over the guidewire along the dilated tract.

15. Aspirate and flush each of the ports with saline to confirm patency and ensure removal of any air bubbles. Dialysis catheters and implantable port catheters should be flushed with heparinized saline 1000U per cc, making sure to infuse only the volume of the catheter to assure no excess heparin enters the patient's bloodstream.



Each channel is gently aspirated to confirm return of blood, then injected with sterile saline. A disposable flush syringe is shown here; if you do not have one of these, draw up saline in a syringe.

16. Secure the hub of the catheter to the skin using suture.



The hub of the catheter is secured to the skin. If this area was not injected with local anesthetic, you may need to do so now.

17. Clean the area and cover with sterile dressing.



A sterile dressing; this one was provided by the manufacturer of the catheter. Note also the catheter caps, which can easily be cleaned, seal each channel of the catheter, and thus reduce the risk of infection.

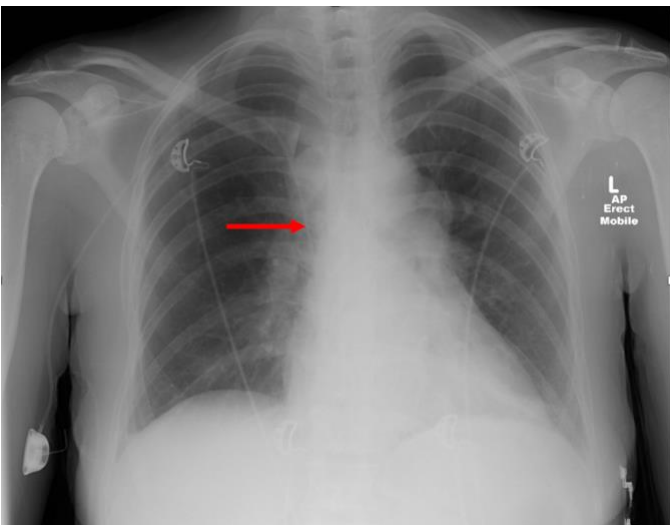
18. Confirm placement with chest x-ray and ultrasound if available. The tip of the catheter should be at the junction of the superior vena cava and the right atrium.

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A chest x-ray can confirm that the catheter is inserted to the correct depth. An ultrasound cannot confirm the depth of the catheter, but it can confirm that it lies within the lumen of the vein at its insertion site.

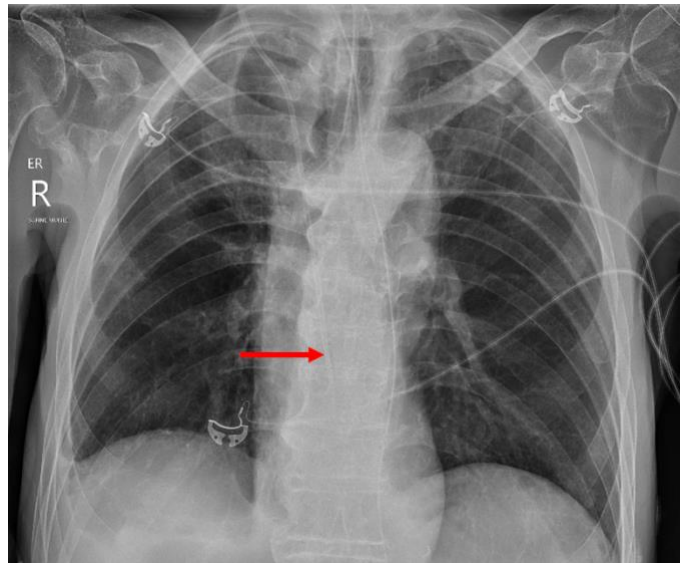


Right subclavian catheter in correct position, going downwards on the right side of the mediastinum and ending at the junction between the superior vena cava and the right atrium. Note that in this case the catheter has been tunneled to the medial upper right arm, where a port has been placed. Case courtesy of Henry Knipe, From the case <https://radiopaedia.org/cases/29405?lang=us>

Pitfalls

- Cardiac arrhythmias: these occur when the wire comes into contact with the endocardium of the right atrium. Gently pull the wire if arrhythmia is noted. These arrhythmias, if they occur, also alert you that the wire is in the right place, i.e. not in the contralateral arm or internal jugular vein. They end immediately when the wire is pulled back.

- Arterial placement: Cannulation of the subclavian artery can be identified via pulsatile blood flow through the needle. Worse, sometimes pulsatile flow is noted after the tract has been dilated and the catheter has been placed. If this occurs, gently remove the wire and catheter, and apply firm pressure for at least 5 minutes. Then choose another site for central line placement. On chest x-ray, arterial malposition of the catheter results in the catheter appearing farther to the patient's left within the mediastinum than would be expected.



As shown here, arterial malposition of a central line will cause the tip to appear more central in the mediastinum, as it extends caudally along the ascending aorta. It may also go downwards on the descending aorta, in which case it would be to the extreme left of the mediastinum. Case courtesy of Craig Hacking, From the case

<https://radiopaedia.org/cases/92311?lang=us>

- Venous malposition: The guidewire may go to other locations besides the superior vena cava, such as the contralateral subclavian vein, or the ipsilateral or contralateral internal jugular vein. In our experience, when you are not able to pass the guidewire to its full length, this complication is more likely. Gently try to reposition the guidewire through the inserting needle, by withdrawing it, rotating it 180 degrees, and then re-advancing it. You may need to remove the

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needle completely and reinsert it into the vein at a slightly different site or angle.

- Pulmonary complications: due to proximity to the apex of the lung, pneumothorax, hemothorax, chylothorax, pneumomediastinum, recurrent laryngeal nerve injury, tracheal injury, and air embolism are complications of central line placement.
- Infection: Central line associated blood stream infection is common if there is any break in asepsis or antiseptic technique during placement or improper care of the central line. All central lines should be placed with full body drapes and gown, gloves, mask and head cover. Remove the central line as soon as it is no longer indicated. Once an infection has been identified, remove the catheter and replace in another site if central line is still needed. If possible, remove the catheter under sterile conditions and culture the tip to identify the organism and know antibiotic sensitivities, especially in a critically ill patient.
- Catheter related venous thrombosis. Having a central line in place increases risk of thrombosis and thus should be removed if indication for placement no longer exist.
- Device dysfunction: Members of the healthcare team should check the catheter for patency daily, and if patency is lost, remove and replace in another site if necessary.

Ariel Santos MD FACS FRCSC FCCM
Texas Tech University Health Sciences Center
Lubbock, Texas, USA

Erin Morris MD
Texas Tech University Health Sciences Center
Lubbock, Texas, USA

Richard Davis MD FACS FCS(ECSA)
AIC Kijabe Hospital
Kenya

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