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Central Venous Catheter Insertion: Subclavian Vein

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Overview

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Central venous access is necessary in a multitude of clinical situations for hemodynamic monitoring, medication delivery, and blood sampling. There are three veins in the body that are accessed for central venous cannulation: the internal jugular, the subclavian, and the femoral vein.

Central venous access via the subclavian vein has several advantages over other possible locations. The subclavian central venous catheter (CVC) placement is associated with lower infection and thrombosis rate than internal jugular and femoral CVC. Subclavian line can be placed quickly using anatomic landmarks and are often performed in trauma settings when cervical collars obliterate the access to the internal jugular (IJ) vein. The most significant disadvantage of the subclavian access is the risk of pneumothorax due to the anatomic proximity to the dome of the lung, which lies just superficial to the subclavian vein. In addition, in the event of an inadvertent arterial puncture, the access to the subclavian artery is impeded by the clavicle, which makes it difficult to effectively compress the vessel.

Successful placement of the subclavian CVC requires good working understanding of the target vessel anatomy as well as fluidity in performing the Seldinger procedure (an introduction of the catheter into a vessel over the guide wire, which is inserted through a thin-walled needle). First, the subclavian vein is cannulated with an 18-gauge thin-walled needle. A guide wire is then passed through the needle until it is appropriately positioned within the vessel. Next, the needle is removed, a dilator is passed over the wire to dilate the skin and soft tissue, and the catheter is passed over the wire until it is appropriately positioned within the vessel. Lastly, the guide wire is removed, and the catheter is sutured in place.

There are several types of CVC kits commonly available marketed by different manufacturers. CVCs may have a single lumen, a double lumen, or a triple lumen. For purposes of this discussion, we will place a triple-lumen CVC, as this is commonly needed when multiple different medications need to be delivered simultaneously. The procedure for placing any type of CVC is the same.

Procedure

1. Assemble the supplies including the CVC kit, sterile gown, sterile gloves, bonnet, mask, saline flushes, any special dressings or antibiotic barriers required at your institution. Commonly marketed CVC kits generally contain the central venous catheter (in this case a triple lumen catheter), a j-tip guide wire, a dilator, a #11 scalpel, an introducer needle, 1% lidocaine, several 3 and 5 mL syringes, several smaller needles (usually 20, 22, and 23 gauge), single straight-suture needle with suture, CVC clamp, dressing, gauze, drape, and chlorhexidine. The contents of the kit are enclosed in a sterile tray wrapped with a sterile cover.

2. Positioning

Place the patient supine with the feet elevated (Trendelenburg position) prior to the start of the procedure. This allows for maximal engorgement of the target vessel and helps to prevent the introduction of an air embolus. Many practitioners find it helpful to place a rolled-up towel under the medial portion of the patient's scapula to help accentuate the physical landmarks, although too much shoulder retraction may decrease the space between the clavicle and first rib, compressing the subclavian vein.

3. Preparation for the procedure

The right subclavian vein is generally preferred for the central venous access because of the presence of the thoracic duct and the higher pleural dome on the left side.

1. Clean the area liberally with chlorhexidine solution, scrubbing vigorously for 60 seconds and allowing to dry for 30 seconds.
2. Open the CVC kit.
 1. Open the flaps of the sterile wrapping by grabbing the non-sterile side of the wrap and opening outward. In this manner the contents of the kit and the exposed surface (inside surface) of the wrapping will remain sterile.
 2. Carefully drop the sterile ultrasound probe cover and saline onto the open sterile kit.
 1. Open the sterile ultrasound probe cover packaging so that the sterile contents drop cleanly onto the sterile field you have just created.
 2. When adding sterile saline to the sterile kit remember that most of the packaging that the sterile saline comes in will not be sterile. Therefore, just the saline should be added to the kit (the tray of the CVC kit has several plastic molded wells in which sterile saline may be squirted).
3. Don mask, bonnet, sterile gown and gloves
4. Drape the patient with the sterile drape
5. Prepare the kit:
 1. Draw lidocaine into the syringe

2. Prepare the guide wire. Initially the end portion of the guide wire advanced past the end of the sheath exposing the J curve (curled back). Retract the guide wire slightly within the sheath; this will allow the J curve to straighten and more easily feed into the introducer needle.
3. Remove the cap of the central lumen (of a triple-lumen catheter) so that the wire can pass freely as you slide the catheter over the wire.
4. Separate the contents of the kit for easy accessibility.

4. Seldinger procedure

The goal in accessing the subclavian vein is to pass the needle just underneath the clavicle, and cannulate the vessel at the point in which it passes between the clavicle and the first rib. The first rib acts as a barrier to the lung underneath.

1. Identify the surface landmarks
 1. Using your non-dominant hand, place your index finger in the sternal notch.
 2. Use your thumb to identify the middle third of the clavicle; this is proximal to where the clavicle bends cephalad. The introducer needle will enter the skin one fingerbreadth below the medial portion of the middle third, and the trajectory is toward your index finger just above the sternal notch.
2. Inject lidocaine into the skin, creating a wheal at the CVC insertion site (1-2 cm inferior to the clavicle transition point), and continue to anesthetize the soft tissues and down to the periosteum of the clavicle along the anticipated trajectory.
3. Insert the introducer needle attached to an empty syringe at a 10° angle to the skin, aiming toward the sternal notch. The needle should graze the underside of the clavicle, passing toward the vessel where it is "sandwiched" between the clavicle and the first rib.
4. Gently pull the plunger while inserting the needle until you are able to freely draw blood into the syringe (once the needle is within the subclavian vein)
5. Carefully detach the syringe from the introducer needle without changing the depth at which the needle is positioned. The needle may be attached by Luer-lock (depending on kit used).
6. Feed the guide wire into the needle to a depth of 15cm (noted by tick marks on the wire itself).
7. Make a nick with the scalpel in the skin around the site of wire insertion and remove the needle from the guide wire, leaving the guide wire in place.
8. Feed the dilator over the guide wire, and dilate the skin and soft tissues with a gentle rotating motion until the dilator is inserted to a depth of 2-3 cm.
9. Remove the dilator, and feed the catheter over the guide wire completely. Remove the guide wire.
10. Attach a syringe with sterile saline to a catheter, and pull the plunger back to verify free blood return
11. Flush all ports with saline, and place appropriate caps on the Luer-lock ports.
12. Use a two-part clamp to hold the catheter in place.
 1. Place the soft rubber part over the catheter at the point where the catheter enters the skin, and then place the hard piece over it, securing the clamp in the chosen position.
 2. Anesthetize the skin, and sew the clamp into place through the eyelets of the clamp.
13. Place a sterile dressing in accordance with your medical facility's practice with regard to reducing catheter-related bloodstream infections.

5. Post-procedure

1. Dispose of all sharps
2. Obtain a chest X-ray to verify proper line placement and to rule out pneumothorax.

Summary

Subclavian vein placement for CVCs is preferred by many practitioners for the rapidity of the procedure, predictable anatomy of the target vessel, and reduced infection rate. Many neurosurgeons and neurocritical care specialists prefer the subclavian vein over the IJ vein due to the lower risk of CVC-associated thrombosis, which carries an additional and unnecessary risk in a patient with increased intracranial pressure (ICP).

As the other CVC placement procedures, subclavian CVCs carry the risk of systemic and local infections, thrombosis, arterial puncture, and bleeding. Since the external pressure cannot be applied to the subclavian artery in the event of accidental puncture, this location is less appealing to many practitioners. Additionally, subclavian vein access is associated with the highest rate of pneumothorax. However, these risks can be reduced with full-barrier sterile precautions, experience, excellent knowledge of the anatomy, and procedural fluidity in the Seldinger technique.