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Central Venous Catheter Insertion: Femoral Vein

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Overview

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Central venous access is necessary in a multitude of clinical situations, including vascular access, vasopressor and caustic medication delivery, central venous pressure monitoring, volume resuscitation, total parental nutrition, hemodialysis, and frequent phlebotomy. There are three veins in the body that are accessed for central venous cannulation: the internal jugular, the subclavian, and the femoral. Each of these vessels has distinct advantages and disadvantages with unique anatomical considerations.

Femoral vein cannulation can be easily performed both under ultrasound guidance and using the surface landmarks; therefore, femoral access is often used when emergent placement of a central venous catheter (CVC) is needed (such as in the case of medical codes and trauma resuscitations). In addition, cannulation of the femoral artery allows one to simultaneously perform other procedures needed for stabilization, such as cardiopulmonary resuscitation (CPR) and intubation.

Successful placement of a femoral CVC requires working understanding of the target anatomy, access to with procedural ultrasound, and fluidity in the Seldinger technique.

Seldinger technique is the introduction of a device into the body over a guide wire, which is placed through a thin-walled needle. In the case of CVC insertion, the device is an intravascular catheter and the target vessel is a central vein. First, the target vessel 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. The needle is removed and a dilator is passed over the wire to dilate the skin and soft tissue to the level of the vessel. The dilator is then removed and the catheter is passed over the wire until it is appropriately positioned within the vessel. Lastly, the guide wire is removed.

The main disadvantage of a femoral CVC is the high incidence of infection due to proximity to the groin (and often as a result of the quasi-sterile nature under which emergent CVCs are placed). Femoral lines should be replaced early on in the patient's hospital course if sustained central access is needed. A line placed with minimal sterility should be replaced as soon as the patient is stable.

Procedure

1. Assemble supplies: CVC kit, sterile gown, sterile gloves, sterile ultrasound probe cover, bonnet, mask, saline flushes, any special dressings or antibiotic barriers required at your institution. Commonly marketed CVC kits generally contain the CVC (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. Place the patient supine, with the leg to be accessed abducted and externally rotated to maximize access to the target area.

3. Identification of the point of access

The point of access for a femoral CVC is lateral to the pubic tubercle and inferior to the inguinal ligament. The inguinal ligament runs diagonally from the anterior iliac spine toward the pubic tubercle. The structures in the superior thigh are often remembered using the mnemonic NAVEL (from lateral to medial: nerve, artery, vein, empty space, inguinal ligament)

1. Using ultrasound
    1. Apply the acoustic gel on the probe.
    2. Standing at the foot of the bed, place the transducer immediately lateral to the pubic tubercle and orient it in a transverse plane by aligning the indicator on the transducer to the left (patient's right) to obtain an accurate cross-sectional view of the anatomy on your ultrasound monitor.
    3. Visualize the vascular structures, applying slight pressure to them with the transducer to distinguish between the compressible femoral vein and the pulsatile femoral artery.

2. Locating the femoral vein using the landmark-based approach
    1. Identify the pubic tubercle by palpation.
    2. Move your palpating fingers laterally from the pubic tubercle until the femoral pulse is located. If the patient has no cardiac activity, the femoral pulsations should match in time with the compressions from cardiopulmonary resuscitation (CPR). The femoral vein is located just medial to the femoral artery (location of the pulse)

4. Preparation

1. Clean the skin with chlorhexidine solution, scrubbing vigorously for 60 seconds and allowing it 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.
    1. Carefully drop the sterile ultrasound probe cover and saline onto the open sterile kit.
    2. Open the sterile ultrasound probe cover packaging so that the sterile contents drop cleanly onto the sterile field you have just created.
    3. 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 sterile drape
5. If using ultrasound, cover the ultrasound probe with sterile cover with the help of a non-sterile helper.
    1. Hold the cover open for the assistant, who has already placed new acoustic gel on the probe. The assistant then gently drops the probe into the opening of the cover.
    2. Hold the probe firmly within the sterile sheath while the assistant pulls the distal end of the cover, unfurling the length of the sheath over the cord. The typical sterile sheath will cover 4 feet of cord.

6. Prepare kit by drawing up lidocaine into a syringe, preparing a guide wire and removing the cap from the middle lumen of the catheter. Separate the contents of the kit for easy accessibility.

5. Seldinger procedure

1. Using ultrasound, again identify the target vessel.
2. Identify the pulsations of the femoral artery, and the compressibility of the femoral vein (as described above 3.1.3)
3. Note the depth at which the femoral vein lies. For example, if the vein is 2 cm deep, the needle needs to be introduced approximately 2 cm inferior to the transducer so that the needle tip reaches the plane of the ultrasound beam at the depth of the target. This is the area that will be anesthetized.
    1. If using a landmark-guided approach, palpate the femoral pulse with the fingers of your non-dominant hand. The femoral vein lies just medial to your fingertips; this is the location at which you will anesthetize the skin and attempt to cannulate the target vessel.

4. Inject lidocaine into skin, creating a wheal, and continue to anesthetize the soft tissues.
5. Insert the introducer needle at a 45° angle to the skin, aiming cephalad.
6. Fan the ultrasound probe in order to follow the tip of the needle toward the target vessel, redirecting the needle as needed.
7. Observe the needle tip as it enters the vessel.
8. Confirm the needle location by drawing blood into the syringe. You should be able to draw blood freely when the needle is in the femoral vein.
9. When performing landmark-guided catheterization, one may not be able to cannulate the femoral vein on the first attempt. The first attempt for the CVC insertion should always be made just medial to the palpable femoral pulse. Subsequent attempts must be performed methodically and incrementally, with each subsequent insertion site just medial to the previous one.
10. Gently remove 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 the kit used).
11. Feed the guide wire into the needle to a depth of 20 cm (noted by tick marks on the wire itself). You may need to reduce the angle of the needle to 30°. The wire should feed easily; you may check that the wire is within the vessel by confirming with the ultrasound in the longitudinal position.
12. If resistance is met, first be certain that the needle angle is not too steep (~30°). If still not passing easily, remove the wire and reattach the syringe to see if blood can still be drawn freely. If not, the needle is no longer in the vessel.
13. If blood does draw freely but there is still difficulty advancing the guide wire, then verify its location within the vessel lumen by using the ultrasound in the longitudinal view (sagittal plane)
14. You may be able to overcome difficulty in passing the wire by retracting the wire a few centimeters and rotating it 90°. This reorients the J tip and may allow for free passage. Never force the guide wire.
15. Make a nick with the scalpel at the level of the skin, and remove the needle from the guide wire.
16. Feed the dilator over the guide wire and dilate the skin and soft tissues with a gentle rotating motion. The dilator should only be inserted to a depth of 2-3 cm. Remove the dilator.
17. Feed the catheter over the guide wire completely, and remove the guide wire.
18. Attach a syringe with sterile saline to a catheter; pull the plunger back to verify free blood return, then flush all ports. Place the appropriate caps on the Luer-lock ports.
19. Use a two-part clamp to hold the catheter in place. Place the soft rubber part over the catheter at the point at which the catheter enters the skin; then, place the hard piece over it, securing the clamp in the chosen position.
20. Anesthetize the skin and sew the clamp into place through the eyelets of the clamp.
21. Place a sterile dressing in accordance with your medical facility's practice on reducing catheter-related bloodstream infections.
22. Post-procedure, dispose of all sharps

Summary

Femoral vein access for CVC insertion is most frequently used in the crashing or coding patient. The femoral lines can be placed quickly, with or without ultrasound guidance, and would not interfere with performing other emergent procedures, such as airway management and CPR.

The immediate complication risks are lower than for IJ and subclavian CVCs. There is no risk of pneumothorax as there is in both IJ and subclavian lines; nor is there any difficulty in controlling accidental arterial hemorrhage from arterial puncture. In the case of an accidental

arterial puncture, the femoral artery can be easily compressed at this site. In addition to the risks of systemic and local infection, arterial puncture and bleeding, and thrombosis associated with any CVC insertion sites, femoral CVCs have a risk of bladder perforation and even peritoneal perforation. Femoral CVCs must be replaced once the patient is stable, with a different CVC placed in an alternative location because of the high infection rate of femoral CVCs.

To enhance procedural fluidity and avoid errors during the CVC placement, it is important to make two important preparations to the kit prior to starting. Be certain to remove the cap to the central lumen, which is the distal port (of a triple-lumen catheter) so that the wire will be able to pass freely as you slide the catheter over the wire. It is also critical to prepare the wire by retracting it slightly within the sheath so that the J curve is straight and can easily feed into the needle.

The most important and difficult aspect of the Seldinger technique in any CVC placement is in cannulating the target vessel and successfully advancing the guide wire. Practitioners often enter the vessel with the needle successfully, only to find that they have difficulty passing the wire once they remove the syringe, which often is due to the needle losing its position and exiting the vessel. To reduce needle migration, it is recommended to brace the hand that holds the needle against the body of the patient. Use of ultrasound allows the practitioner to verify needle location within the vessel.