

Central Venous Access Techniques



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KEYWORDS

- Central venous access • Internal jugular vein catheterization • Subclavian vein catheterization
- Femoral vein catheterization • Vascular access • Catheter

KEY POINTS

- Central venous access can be obtained if peripheral venous access is inadequate or if there is a need for total parenteral nutrition administration, invasive hemodynamic monitoring, transvenous pacing, and placement of pulmonary artery catheters.
- Absolute contraindications to central venous access are venous thrombosis, untreated coagulopathy, thrombocytopenia (<50,000), fungating tricuspid valve endocarditis, and renal cell tumor extending into the right atrium.
- Femoral venous access is used as a site of last resort because of the increased risk of thrombosis, embolism, and infection.
- Complications associated with central venous catheterization include catheter misplacement, arterial puncture, hemorrhage, pneumothorax, thoracic duct injury, extravasation of fluids, medications, hyperalimentation, dysrhythmias, brachial plexus injury, air embolism, catheter or wire embolization, hydrothorax, thrombosis, and infection (central-line-associated bloodstream infection [CLABSI]).
- Complications can be minimized by good sterile technique during placement, proper patient positioning and procedure performance, appropriate catheter maintenance postplacement, and proper removal technique.
- Use of image guidance should be considered if available to improve success and reduce the incidence of complications.

Introduction

A German surgical resident, Werner Forssmann, self-catheterized one of his own left antecubital veins and then radiographically confirmed the tip placement within his right atrium in 1929. Thus began a new era in venous access for multiple purposes. At present, in the United States alone almost 15 million central venous access procedures are performed annually. Patients presenting for surgical procedures using intravascular administration of medication, patients presenting to the emergency department for acute care, and most patients admitted to the hospital require some sort of vascular access device. For most of these patients, a peripheral venous access device suffices with low morbidity. Upper extremity veins are the most recommended and used veins including the median, basilic, and cephalic veins. Lower extremity venous access can also be achieved but has a much higher complication rate of phlebitis and infection and is not routinely recommended.

Central venous access can be obtained if peripheral venous access is inadequate or if there is a need for total parenteral nutrition administration, invasive hemodynamic monitoring, transvenous pacing, and placement of pulmonary artery catheters (Box 1). Large vessel lumens lessen the risks of vessel irritation and phlebitis and provide rapid administration of medications to the central circulation. A few catheter types in

use are Hickman, Groshong, and Broviac catheters. There are also various implantable ports that can be placed to maintain long-term central venous access. Absolute contraindications to central venous access are venous thrombosis, untreated coagulopathy, thrombocytopenia (<50,000), fungating tricuspid valve endocarditis, and renal cell tumor extending into the right atrium. Anticoagulation is a relative contraindication (Box 2).

This article discusses obtaining central venous access with multilumen Silastic catheters in 3 sites: internal jugular vein, subclavian vein, and femoral vein.

Equipment

Arrow Pressure Injectable Multi-Lumen CVC Kit or similar (Box 3, Figs. 1 and 2).

ChloroPrep or povidone-iodine scrub (if not included in the kit).

Absorbent pads (Chux pads).

Internal jugular venous access

A specific contraindication to internal jugular venous access is ipsilateral carotid endarterectomy if image guidance is not used. Internal jugular catheterization is intermediate in risk between subclavian venous catheterization and femoral artery catheterization for postplacement infection.

Pertinent anatomy

The internal jugular vein arises at the base of the skull and is located in the carotid sheath posterior to the internal carotid artery. The internal jugular vein terminates as the subclavian

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Box 1. Indications for central venous access

- Inadequate peripheral venous access
- Need for total parenteral nutrition administration
- Invasive hemodynamic monitoring
- Transvenous pacing
- Placement of pulmonary artery catheters

vein anterior and lateral to the common carotid artery. The course of the internal jugular vein is medial to the sternocleidomastoid muscle at its superior extent and posterior in the triangle formed by the sternal and clavicular heads. At the inferior part, the vein is deep to the clavicular head (Figs. 3 and 4).

Technique

There are 2 approaches for internal jugular venous catheterization, the central approach and the posterior approach. Right internal jugular veins have the straightest course to the right atrium and the lowest complication rate.

Central approach

1. Place absorbent pads beneath the patient (Fig. 5).
2. Position patient in Trendelenburg position.
3. Rotate the patient's head 45° to the contralateral side.
4. Locate the apex of the triangle formed by the heads of the sternocleidomastoid muscle and the clavicle.
5. Prepare and drape the neck.
6. Scrub and gown for sterile procedure.
7. Using the 3-mL Luer lock syringe and 25-gauge needle, anesthetize the skin and subcutaneous tissues at the apex of the triangle.
8. Palpate the carotid pulse and apply gentle medial traction.
9. Insert the finder needle, 22 gauge with a 5-mL Luer lock syringe attached, at the apex of the triangle at a 45° to 60° angle to the skin surface advancing slowly toward the ipsilateral nipple and aspirating.
 - a. If venous blood return is not noted after the needle has been inserted 3 cm, slowly withdraw the needle while aspirating.
 - b. If venous blood return is still not noted, reintroduce the needle through the same puncture site but direct the needle 1 to 3 cm more laterally.
 - c. If venous blood return is still not noted, reintroduce the needle through the same puncture site but direct the needle 1 cm medially.
 - d. If venous blood return is still not noted, consider changing to the posterior approach.
10. If good venous blood return is noted, leave the finder needle in place as a guide for the introducer needle. Using

Box 2. Contraindications to central venous access

- Venous thrombosis
- Untreated coagulopathy
- Thrombocytopenia (<50,000)
- Fungating tricuspid valve endocarditis
- Renal cell tumor extending into the right atrium
- Anticoagulation (relative contraindication)

Box 3. Contents of Arrow Pressure Injectable Multi-Lumen CVC Kit, CDC-45703-XP1A (Teleflex, Morrisville, NC)

- Multilumen indwelling catheter 7F × 20 cm (16 and 30 cm catheter lengths are also available)
- Spring-wire guide, marked 0.81 mm × 60 cm
- 18-gauge × 2.5-in catheter, with 20-gauge needle
- Pressure transduction probe
- Injection needle, 22 gauge × 1.5 in
- Injection needle, 25 gauge × 1 in
- 3-mL Luer lock syringe
- 5-mL Luer lock syringe
- Introducer needle, echogenic, 18 gauge × 2.5 in
- 5-mL Arrow Raulerson (Teleflex, Morrisville, NC) spring-wire introduction syringe
- Tissue dilator
- 3-mL applicator pouch, 2% chlorhexidine gluconate, and 70% isopropyl alcohol Chloraprep one-step solution with Hi-Lite Orange tint
- 5-mL ampule 1% lidocaine solution
- 1 pack 62% alcohol hand gel
- 10-mL Luer lock syringe (quantity 2)
- Catheter clamp
- Fastener, catheter clamp
- SharpsAway II, locking disposal cup
- CSR wraps
- Maximal barrier drape with 4-in fenestration
- Towel
- Needle holder
- Safety scalpel, No. 11 blade
- Checklist/CLIP (Central Line Insertion Practices) sheet
- Flow rate information card with injection log
- Medication label, 1% lidocaine
- Sterile procedure sign
- Dressing, BIOPATCH (Ethicon, Cincinnati, OH)
- Dressing, Tegaderm (3M, St. Paul, MN), 10 cm × 12 cm
- Gauze pads, 2 in × 2 in; quantity 2
- Gauze pads, 4 in × 4 in; quantity 5
- Surgical apparel: bouffant cap, impervious gown, mask with eye shield
- 3-0 silk suture with curved needle
- HemoHopper (Teleflex, Morrisville, NC) fluid receptacle

- a. Raulerson syringe on the introducer needle, follow the tract of the finder needle while aspirating.
11. Once venous blood return is noted in the introducer needle, insert the guidewire through the Raulerson syringe (Seldinger technique). If a Raulerson syringe is not available, remove the syringe and occlude the needle to prevent air embolism and then introduce the guidewire.
 - a. Never lose control of the guidewire (Fig. 6).
 - b. The guidewire should advance freely.
 - c. If resistance is encountered, remove the wire and confirm positive venous blood return before reintroducing the guidewire.
 - d. Insert the wire to about 20 cm.
 12. Make a nick in the skin with the scalpel blade.
 13. Place the dilator over the guidewire and push the dilator into the vein. Do not push the dilator in more than half its length to avoid vein injury.

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