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Best practices for CVAD care

Following evidence-based guidelines for catheter maintenance is essential to promote positive patient outcomes.

By Jennie R. Alspach, DNP, CRNP, FNP-BC

A central venous access device (CVAD), also known as a central line or central venous catheter (CVC), is an essential component of routine patient care. A flexible catheter is inserted into a venous great vessel, most commonly the internal jugular, subclavian, brachiocephalic, or femoral veins, and terminates in the vena cava or right atrium, providing access to the central circulation (see *CVAD placement*). The catheter can have up to five lumens, making it easier to administer several treatments at once, especially incompatible drugs, due to the turbulent and large blood volume within the great vessels.

After placement, the nurse assesses the catheter exit site, which includes examining the dressing, observing for signs of infection, and evaluating the functionality of the CVAD.[1] Facility policy and patient status determine the assessment frequency, but it typically occurs with each shift and medication or fluid infusion. Although nurses are responsible for managing patients with I.V. lines, only those with specialized training and following state board of nursing guidelines may insert or remove CVADs.[1] All healthcare providers working with CVADs should receive updated education and training and complete competency evaluations to ensure that proper technique and infection control measures are utilized.[1-3]

Indications

A CVAD can be left in place short term (days) or long term (weeks to years) and is used for a wide range of situations, including:

- long-term I.V. therapy or therapy caustic to peripheral veins (total parenteral nutrition, chemotherapy, and medications)
- unattainable or difficult venous access
- extracorporeal therapies (hemodialysis, plasmapheresis, and continuous renal replacement therapy)
- hemodynamic monitoring or facilitation of procedures
- frequent blood sampling
- trauma/burn resuscitation (blood transfusions and large volumes of fluids).[4]

Types

There are several different types of CVADs. The patient's medical diagnosis and condition, history, type of care

needed, and anatomy, as well as factors such as duration and type of infusion, will determine which one of the following is best:

- peripherally inserted central catheter
- nontunneled CVC
- tunneled CVC
- implanted port.[4]

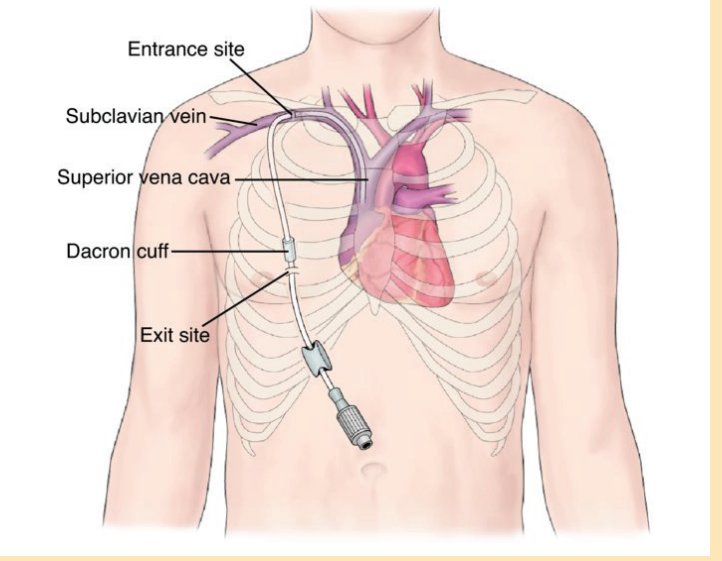
Except for femoral catheters, diagnostic confirmation of placement, most commonly with radiography, is required before infusion.[4]

Complications

The nurse must be knowledgeable regarding common complications associated with CVADs, including placement issues, catheter occlusion, thrombosis and embolus, dislodgement and migration, infiltration and extravasation, and infection. The severity of the complication may necessitate removal.

CVAD placement

The CVAD is inserted into the subclavian vein and advanced until its tip lies in the superior vena cava just above the right atrium. The proximal end is then tunneled from the entry site through the subcutaneous tissue of the chest wall and brought out through an exit site on the chest.



Source: Honan L. *Focus on Adult Health: Medical-Surgical Nursing.* 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2018.

Placement issues

Complications, such as bleeding, pneumothorax, arterial injury, and arrhythmias, are often associated with insertion by inexperienced providers and are dependent on the access site.[5] Avoiding use of the femoral vein and ultrasound guidance by experienced providers can reduce complications associated with insertion.[4]

Catheter occlusion

The patient's catheter may be occluded if there's no blood return, resistance with flushing, slow infusion, or swelling or leakage at the site.[1] Assess for an external cause of obstruction by checking lines for kinks, closed clamps, restrictive dressing, tight suture, malfunctioning needleless connector or add-on device, and blockage of the catheter tip against the vessel wall.[1] Have the patient reposition, place the ipsilateral arm above the head, cough, and hold a deep breath in an attempt to resolve catheter position issues.[1]

If there's no evidence of an external cause and the catheter remains nonfunctioning, notify the primary care provider (PCP) because diagnostic tests may be indicated to determine an internal cause of the occlusion and need for a thrombolytic such as tissue plasminogen activator.[1] Appropriate flushing and clamping are crucial aspects of maintenance care to prevent occlusion.

Thrombosis and embolus

Deep vein thrombosis (DVT) most often develops in the upper extremities when a patient has a CVAD. If the patient complains of extremity pain and erythema and edema are present during assessment, measure the arm's circumference 10 cm above the antecubital fossa and compare it with the documented circumference at placement.[1] Immediately notify the PCP of a possible thrombosis, prepare the patient for diagnostic imaging such as duplex ultrasound, and anticipate treatment of confirmed DVT with anticoagulants.[5]

Although less common with upper extremity DVT, prompt diagnosis and

treatment are essential to prevent embolus. Early warning signs include sudden shortness of breath; chest, shoulder, or low back pain; and altered mental status.[5] Early interventions preventing blood stasis include range-of-motion exercises and handgrip exercises, which should be implemented soon after catheter placement.[1]

Air embolism occurs when air enters the venous circulation during catheter insertion, access, or removal.[1] Symptoms may go unnoticed or the patient may experience cardiopulmonary embolus signs with respiratory distress or cardiovascular collapse.[5] If you suspect air embolism, clamp the catheter, place the patient in the left lateral decubitus position or in the Trendelenburg position to prevent further embolization, and administer high-flow oxygen.[6] Mechanical ventilation, rapid resuscitation with fluids and vasopressors, and advanced cardiac life support may be necessary for patients with respiratory distress or marked hemodynamic instability.[6] Prevention measures include applying connector caps to each lumen hub, clamping lumens when not in use, and appropriately priming administration devices.[1]

Dislodgement and migration

Although a suture-less securement device aids in CVAD stabilization, the risk of accidental dislodgement with patient movement and dressing change exists. With each dressing change and catheter access, measure from the insertion exit site to the lumen hub using a sterile tape measure or the incremental markings on the catheter, comparing the result with the documented placement length.[7] Notify the PCP if you suspect the catheter has dislodged or migrated. Prepare the patient for radiography or other diagnostic tests to confirm placement.[1]

Infiltration and extravasation

Infiltration occurs when a nonvesicant drug or solution leaks into the extravascular space, whereas extravasation results when a vesicant drug or solution leaks into the extravascular space. Both result in tissue injury. The patient may complain of pain at or near the catheter exit site.[1] Other signs include leakage of fluid from the site, noticeable extremity edema near the CVAD, vesicle formation, and ulceration. Erythema and blanching of the skin are signs of superficial infiltration and extravasation.

Immediately stop the infusion, disconnect the administration set, and assess for blood return. Don't flush afterward to limit additional infusion of the vesicant.[1] Next, compare extremities and the circumference with baseline measurement at placement. Outline the area with a skin marker to assess progression. Elevate the extremity and apply dry heat or a cold compress based on the medication/fluid properties to reduce inflammation and promote tissue reabsorption. Lastly, notify the PCP and prepare the patient for radiography or other diagnostic tests to determine catheter placement. Additionally, prescribed antidotes and medications can reduce inflammation and edema.[1] Site assessment and assurance of adequate blood return and flushing are essential for limiting local tissue damage.

Infection

Patients treated in a medical facility can develop a healthcare-associated infection (HAI). According to the CDC, one in 31 US hospital patients have at least one HAI on any given day.[8] A central line-associated bloodstream infection (CLABSI) is one type of HAI that occurs when bacteria or viruses enter the bloodstream through the line during insertion or maintenance.[3] In 2019, before COVID-19, there were 18,009 reported CLABSI cases across US general acute care hospitals, which was significantly lower than 2018 reported cases.[9] However, due to the impact of the national pandemic, CLABSI rates increased 47% from October to December 2020, making infection control a continued effort to realize HAI elimination.[10]

Signs and symptoms of a CLABSI are systemic and include bacteremia, fever of

CVAD assessment cheat sheet

- Perform a daily risk assessment for the continuous necessity of the CVAD.
- Ensure that the securement device is stable and the dressing is clean, dry, and intact.
- Compare the catheter length with the recorded measurement at placement.
- Assess for signs of infection, such as bacteremia, fever of 100.4° F or higher, chills, malaise, hemodynamic instability, erythema, tenderness, warmth, induration, swelling, and exudate around the site.
- Confirm each hub has an intact Luer-locking needleless connector.
- Check the expiration date of infusion sets if applicable.

100.4° F (38° C) or higher, chills, malaise, and hemodynamic instability.[11] If the patient develops a local infection, you may notice erythema, tenderness, warmth, induration, swelling, and exudate at the exit site or over the skin where a tunneled catheter indwells.[11] Notify the PCP and prepare to obtain blood cultures to rule out CLABSI or a site culture to rule out local infection.[1]

Collect specimens for culturing before administering I.V. or topical antimicrobial therapy to avoid interfering with identifying the causative agent. Continue to assess vital signs and monitor the patient's condition. Strict adherence to site asepsis and daily catheter maintenance is crucial to infection prevention.

Evidence-based practices for catheter maintenance

Through implementation evidence-based interventions, nurses have an essential role in reducing CLABSI rates and improving patient outcomes. In 2011, the CDC developed its Guidelines for the Prevention of Intravascular Catheter-Related Infections, which were revised in 2017.[2] In 2012, the Institute for Healthcare Improvement (IHI) created a central line bundle based on these recommendations.[3] Reflecting on these guidelines and the best, most current evidence, the Infusion Nurses Society developed its Infusion Therapy Standards of Practice (ITSP) in 2016, which were revised in 2021 to promote consistency in patient care and clinical decision-making.[1]

The evidence-based practices for catheter maintenance presented in this section summarize the ITSP recommendations, which focus on the IHI's central line bundle:

- hand hygiene
- maximal barrier precautions (surgical caps, sterile gloves and gowns, full-size sterile drapes, masks, and central line insertion checklists)
- chlorhexidine gluconate (CHG) skin antisepsis
- avoidance of femoral vein insertion site in adults
- daily review of line necessity.

Although there's no standardized maintenance care checklist, incorporating the five care components into facility policies and procedures aligns with best practices promoting education, teamwork, and care collaboration. Central line checklists, prepackaged CHG antisepsis/dressing supply kits, universal precaution supplies, and hand hygiene signage to promote efficiency and adherence to recommended guidelines are suggested.[1-3]

Don't delegate assessment and care of a CVAD to unlicensed assistive personnel.[1] It's important to know your state's nurse practice act to determine if CVAD dressing changes are within the scope of practice for the LVN. Always consider the patient's circumstances and needs when delegating care.

Aseptic nontouch technique

Use strict asepsis when managing CVADs to prevent infection. The aseptic nontouch technique (ANTT) incorporates "key parts" and "key sites" to prevent contamination by hands, surfaces, or equipment.[1] The key parts of a CVAD are the catheter segments inserted into and indwelling in the patient, the connector access port, and the open lumen of a catheter. The key site is the catheter exit site and surrounding

skin. The goal is to avoid touching any key area, even while wearing gloves.[1]

Nonsterile gloves are used for procedures when key areas won't be touched, such as accessing connector ports for infusion or injection, flushing and locking, and routine blood sampling.[1] However, there are occasions when you must touch a key area or it's likely that a key area will accidentally be touched, such as palpating an uncovered site, changing caps or dressings, and removing CVADs. In these situations, utilize a sterile single-use kit or barrier, sterile gloves, and masks.[1]

Effective and frequent hand hygiene is an essential component of ANTT. Use a 60% to 70% alcohol-based hand rub or soap and water to cleanse hands for 20 seconds.[1] Perform hand hygiene any time hands are visibly soiled or contaminated; before donning gloves to palpate the catheter site, manipulate the catheter, or change the dressing; and after doffing gloves.[1]

Daily assessment

The interdisciplinary team assesses the CVAD daily to prevent complications and determine its continued necessity. Nonessential catheters should be removed promptly. Following the ITSP, ensure that each lumen hub has a Luer-locking needleless connector attached to reduce the entry of microorganisms into the catheter.[1] Additionally, inspect the skin integrity at the exit site and whether the dressing is clean, dry, and intact (CDI), observing for signs of infection. If the dressing is CDI, palpate the site wearing clean gloves.

Check the stability of the suture-less securement device and measure the catheter length, comparing it with the recorded measurement at placement. Change the dressing and securement device immediately if there are signs of infection; the dressing is soiled, damp, loose, or overdue for change; or the securement device is displaced. Otherwise, follow the schedule for routine dressing changes to replace the securement device with each dressing change or according to the manufacturer's directions.

key points

Priority nursing care

- Apply principles of ANTT when managing CVADs, wearing masks and clean or sterile gloves as indicated.
- Change TSM dressings every 7 days and a sterile gauze dressing every 2 days.
- Change the suture-less securement device with the dressing change or according to the manufacturer's guidelines.
- Replace the needleless connector and extension set with add-on devices no more frequently than every 96 hours and at least every 7 days.
- Scrub the hub of the catheter lumen with a sterile alcohol-based CHG pad or a 70% isopropyl alcohol pad for 15 seconds and cleanse each catheter lumen, including the clamps and stopcocks, with a sterile disinfectant swab during each dressing change, needleless connector change, and connector access.
- Disinfect the skin with an alcoholic 2% CHG-impregnated sponge for 30 seconds during a dressing change.
- Use a CHGISD directly over a securement device and site per facility policy.
- Use a skin barrier solution before applying a suture-less securement device and dressing.
- Clamp the catheter lumen before a needleless connector change, aspirate for 1 to 2 mL of blood return, and flush with at least twice the internal volume of the CVAD and any add-on device.
- When accessing the needleless connector port, assess for blood return and flush with 10 mL of preservative-free 0.9% sodium chloride, increasing to 20 mL after vesicant medication administration and blood sampling.
- For a positive-pressure needleless connector, flush and clamp the catheter after disconnecting the syringe.
- For a negative-pressure needleless connector, flush and maintain pressure on the syringe while clamping the catheter before disconnecting the syringe.
- For a neutral and antireflux needleless connector, no specific sequence is required for flushing and clamping.
- Apply a cap with or without an alcoholic disinfectant to the needleless connector end and clamp lumens when not in use.
- Protect the patient's CVAD with a waterproof cover or wrap and bathe patients older than age 2 months with CHG daily.
- Document site care and patient education.

Lastly, assess the expiration date of infusion sets and replace, along with add-on devices, no more frequently than every 96 hours and at least every 7 days. Change the tubing within 24 hours of blood, blood product, or fat emulsion infusions.[1,2]

Dressing changes

A transparent semipermeable membrane (TSM) dressing that's CDI may remain in place for up to 7 days and a sterile gauze

dressing that's CDI up to 2 days.[1] TSM dressings are preferred; however, use a gauze dressing for patients with site drainage, allergies to TSM dressings, or excessive perspiration. Some facilities use a CHG-impregnated sponge dressing (CHGISD) directly over a securement device and site to reduce infection rates.[1] Maintaining asepsis during the dressing change remains critical to infection prevention.

When initiating site care, don a mask, provide the patient with a mask, and perform hand hygiene before donning clean gloves.[1] Be careful not to dislodge the catheter or damage the skin when removing the dressing. Using a sterile, nonacetone adhesive remover can safely loosen the dressing and securement device if needed.[7] Support the skin by pulling the dressing perpendicular to the skin toward the catheter site and remove the CHGISD if present.

After removing the dressing and securement device, perform hand hygiene and don sterile gloves. First, observe the site for bleeding and signs of infection and assess the integrity of the catheter.[1] If needed, remove excess hair at the site with sterile scissors or clippers (don't shave). Next, use a new sterile disinfectant swab, applying friction to cleanse each catheter lumen, including the clamps and stopcocks, moving toward the direction of the patient; repeat until the catheter is visibly clean. Continue to hold the catheter lumen while disinfecting the skin with an alcoholic 2% CHG-impregnated sponge, moving in a back-and-forth or side-to-side motion for 30 seconds to create enough friction to kill pathogens and allow the skin to dry; 70% isopropyl alcohol or povidone-iodine is acceptable for CHG allergies.[1]

Lastly, use a skin barrier solution before applying the new securement device and dressing to protect patients from medical device-related skin injury.[1] If applicable, affix a CHGISD over the securement device covering the insertion site. Consider dressings and tape designed for fragile skin if the patient is prone to skin injury.[7] Label the dressing with the date and time of application and your initials. Once the site of a tunneled CVAD has completely healed, the catheter may be left uncovered.[1]

Needleless connector changes

The needleless connector is often replaced with the primary administration set, no more frequently than every 96 hours, but at least every 7 days.[1] Also, replace needleless connectors whenever blood within the connector can't be flushed, before blood sampling for culture, and when contaminated. Clamp the catheter lumen before the needleless connector change, if applicable, to prevent air embolism.[1]

Apply the principles of ANTT and include masks and sterile gloves when changing needleless connectors.[1] Prime the sterile needleless connector with a sterile prefilled 10-mL syringe or a syringe with a low injection pressure of preservative-free 0.9% sodium chloride solution. Removing air bubbles and leaving the syringe attached to the connector, place it on the sterile field. Sterile gauze can be used to stabilize the catheter and remove the old connector.

Scrub the hub of the catheter lumen with a sterile alcohol-based CHG pad or a 70% isopropyl alcohol pad for 15 seconds using a twisting motion and disinfect the CVAD connection surfaces as performed with a dressing change. Allow the catheter to dry, then attach the new primed connector. Unclamp the catheter, aspirate for 1 to 2 mL of blood return, and flush with at least twice the internal volume of the CVAD and any add-on device. Apply a sterile cap protector to the end of the needleless connector hub after flushing. Alternatively, apply a disinfectant end cap containing an alcohol-based agent for passive disinfection between uses.[1]

Accessing the needleless connector

Cleansing the CVAD connector port and the connection surfaces should occur with each access.[1] Perform hand hygiene and

don clean gloves to access needleless connectors. Remove the end cap from the connector. Using ANTT, scrub the hub of the connector access port for 15 seconds and disinfect the catheter connection surfaces. Before use, allow the connector access port to completely dry and assess for a brisk blood return, followed by flushing with 10 mL of preservative-free 0.9% sodium chloride solution, increasing to 20 mL after vesicant medication administration and blood sampling. Use sterile prefilled syringes or syringes with lower injection pressure for flushing. If administering a medication via the direct I.V. route, flush at the same infusion rate so the medication left in the catheter infuses at the appropriate rate.[1]

Flushing and locking

The nurse must be familiar with the types of needleless connector devices to understand how to flush and lock CVADs to reduce the amount of blood reflux that can result in coagulation and occlusion inside the lumen.[1] For a positive-pressure needleless connector, flush and clamp the catheter after disconnecting the syringe. For a negative-pressure needleless connector, flush and maintain pressure on the syringe while clamping the catheter before disconnecting the syringe. For a neutral and antireflux needleless connector, no specific sequence is required.

Flushing the CVAD is recommended every shift or daily if the patient doesn't receive a continuous infusion.[1] Additionally, flush after blood sampling and before and after each infusion. Whenever a patient complains of pain or you're concerned about the device malfunctioning, check the catheter for patency and attempt to flush it. A pulsatile flushing technique alternates short boluses of flush solution and short pauses, which may be superior to a continuous low-flow technique at removing deposits that cause occlusion and infection. Check the patient's medical orders for an additional heparin flush (10 mL/unit) for patency maintenance. After flushing, apply a cap with or without an alcoholic disinfectant to the end of the needleless connector.[1]

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Special considerations for an indwelling vascular access port

Before accessing an indwelling vascular access port, disinfect the skin with alcoholic 2% CHG. Maintain a sterile dressing over the site during use.[1]

Bathing

Daily bathing with CHG in patients older than age 2 months is associated with reduced rates of CLABSI.[1] Avoid contamination with water during a bath or shower by protecting the patient's CVAD with a waterproof cover or wrap.[1]

Documentation

With any procedure, accurate and timely documentation is vital for safe, quality care. The catheter type and insertion date are tracked daily and documented, along

with assessment findings of the site and catheter condition.[1] Site care, including blood return, flushing and locking, type of dressing change, securement change, connector change, and end cap change, is also documented. Note any complications, interventions implemented, and the patient's response. Additionally, include patient and family education, understanding of the education, and continuing education needs.[1]

Staying up-to-date

A CVAD delivers therapy directly into the central venous system, making it a better option for quick-delivery treatments, long-term therapy, irritant or large volume infusions, hemodynamic monitoring, and frequent blood sampling. However, CVADs increase the risk of patients developing complications. Healthcare providers working with CVADs must follow evidence-based guidelines for maintenance and maintain up-to-date training and education for the best patient outcomes. ■

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