Preventing and Managing Central Line-Associated Bloodstream Infections

Background

Central line-associated bloodstream infection (CLABSI) is defined as a laboratory-confirmed bloodstream infection (not related to an infection at another site) where a central line was in place within the 48-hour period before the development of the infection (NHSN, 2024). CLABSI is a term used by the Centers for Disease Control and Prevention (CDC) for surveillance purposes. CLABSI can be prevented through proper insertion techniques and management of the central line.

Sources of catheter contamination (Nickel et al., 2024)

- Skin organisms that enter the blood during catheter insertion or by contaminated dressings
- Contamination of the catheter or hub by hands or devices that transmit bacteria
- Infection from another area in the body travels through the bloodstream and into the catheter
- Contaminated infusions administered via catheter

Definitions related to CLABSI surveillance (NHSN, 2024):

- Primary bloodstream infection (BSI): a laboratory-confirmed bloodstream infection that is not secondary to an infection at another body site
- Secondary BSI: a bloodstream infection that is thought to be seeded from a site-specific infection at another body site

Central Line Insertion and Management Checklist

Follow proper insertion practices (Nickel et al., 2024; Gupta et al., 2021)

- Select central venous catheter (CVC) based on the intended purpose and duration of use.
  - Use a midline catheter or peripherally inserted central catheter (PICC) if therapy is anticipated to be longer than six days.
  - Use CVCs with a minimal number of ports or lumens needed to care for the patient.
- Select the best insertion site to minimize infections and based on patient characteristics.
  - Avoid femoral vein for CVC access in adult patients.
  - Use subclavian vein instead of internal jugular, if possible, for non-tunneled CVCs and short-term therapy.
  - Avoid subclavian vein in hemodialysis patients and those with advanced kidney disease which may cause subclavian vein stenosis. Use a fistula or graft for permanent dialysis access.
- Perform hand hygiene by washing hands with soap and water or with alcohol-based hand rubs (ABHR) before and after inserting, replacing, accessing, repairing or dressing a CVC.
- Maintain aseptic technique.

  - If aseptic technique cannot be ensured (e.g., catheter inserted during an emergency), replace the catheter as soon as possible, preferably within 48 hours.
- Use maximal sterile barrier precautions including cap, mask, sterile gown, sterile gloves, and sterile full body drape.
- Prepare the insertion site with 2% chlorhexidine with alcohol.
  - If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol may be used. Safety of chlorhexidine in infants younger than two months of age is unknown.
  - Allow antiseptics to dry according to manufacturer's recommendation before skin puncture.
- Ultrasound guidance may be used by trained staff to avoid multiple attempts. Use sterile single-use ultrasound gel.
- To stabilize the external portion of the catheter to the skin, use a securement device, which prevents motion of the CVC within the vessel lumen.
- Place a sterile gauze dressing or sterile, transparent, semipermeable dressing over the insertion site.
  - If there is bleeding at the site, use gauze until the site is dry.
  - Consider using gauze, sterile absorbent dressing, or gum mastic liquid adhesive for adult patients experiencing diaphoresis.
- Unless contraindicated, for patients 2 months of age and older, use a chlorhexidine-impregnated dressing with a Food and Drug Administration (FDA) approved indication to reduce CLABSI or catheter-related bloodstream infection (CRBSI) for short-term, non-tunneled central venous catheter insertion site protection.
- For premature neonates, chlorhexidine-impregnated dressings are NOT recommended to protect the site due to risk of serious adverse skin reactions.

Central Line Management (Buetti et al., 2022)

- Bathe ICU patients over two months of age with chlorhexidine preparation daily.
- Scrub access port or hub before each use with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor, or 70% alcohol).
- Use sterile devices to access catheters/ports and use a needleless system to access IV tubing.
- Perform routine dressing changes using aseptic technique with sterile gloves.
  - Change the dressing if it becomes loose, damp, or soiled.
  - Change gauze dressings on short-term CVCs at least every two days.
  - Change semipermeable dressings on short-term CVCs at least every seven days.
  - Regularly monitor catheter sites visually when changing the dressing or by palpation through an intact dressing. If patient has tenderness at the insertion site, fever without an obvious source, or other symptoms of infection, remove the dressing and assess the site.

- Change administration sets for continuous infusions no more frequently than every four days, but at least every seven days.
  - For blood and blood products, continuous or single unit, change after four hours.
  - For fat emulsions and parenteral nutrition change tubing within 24 hours of initiating the infusion.
  - If propofol is administered, change tubing every 6-12 hours or when the vial is changed.
- Advise patients to avoid submerging the catheter site in water for CVCs not tunneled or implanted (and for tunneled CVCs that are not healed).
  - Patients may shower if the catheter and dressing are protected with an impermeable dressing.
- Do not use topical antibiotic ointment or creams at insertion site, except for dialysis catheters, as these may promote fungal infections and antimicrobial resistance.
- Do not administer systemic antimicrobials or anticoagulants prophylactically.
- Promptly remove nonessential catheters.
  - Assess the need for each CVC daily.
    - Do not remove CVCs based on fever alone; use clinical judgment before removal.
    - Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections.

Other Strategies

- Consider using antimicrobial/antiseptic-impregnated catheters and cuffs (chlorhexidine/silver sulfadiazine or minocycline/rifampin) when the CVC duration of use exceeds five days.
- Consider using antiseptic-impregnated caps for access ports.

Diagnosis

- If infection is suspected, notify the healthcare provider immediately.
  - Symptoms may include fever, hemodynamic instability, altered mental status, catheter dysfunction, and clinical signs of sepsis that start immediately after catheter infusion.
- If infection is suspected, draw two sets of blood cultures: one from the CVC and one from a peripheral vein before antibiotic administration (Nickel et al., 2024).
  - If blood cannot be drawn from a peripheral vein, blood may be drawn from different lumens of multi-lumen catheters (two or more blood samples should be drawn from lumens at different times).
  - Blood cultures positive for *S. aureus*, coagulase-negative *staphylococci*, or *Candida* species in the absence of other sources of infection should increase the suspicion of catheter-related infection.
  - Catheter tip cultures should be performed when a catheter is removed for suspected infection.

Treatment (Calderwood, 2023)

- Once the infection is confirmed, the healthcare provider must determine if the catheter will be removed, salvaged, or exchanged.
- Catheters should be removed in the following circumstances:
    - Severe sepsis/septic shock
    - Hemodynamic instability
    - Endocarditis or evidence of metastatic infection
    - Erythema or exudate due to thrombophlebitis
    - Persistent bacteremia after 72 hours of antimicrobial therapy
    - Subcutaneously tunneled catheter tunnel tract infection or subcutaneous port reservoir infection
- Benefits of catheter removal must be weighed against the difficulty in obtaining alternative venous access.
- Long-term catheters (indwelling greater than or equal to 14 days) infected with *S. aureus*, *P. aeruginosa*, fungi, or mycobacteria, as well as organisms that are difficult to treat (*Bacillus* spp, *Micrococcus* spp, or cutibacteria) should be removed.
- Long-term catheters with uncomplicated infection due to pathogens other than those listed above, may be salvaged.
- Nontunneled catheters should not be exchanged over a guidewire if the catheter is suspected of infection (Nickel et al., 2024).
- If the catheter cannot be removed, an adjunctive antibiotic lock therapy combined with systemic therapy may be used in infections due to coagulase-negative *staphylococci*. Antibiotic lock therapy should not be used for extraluminal infections or infections due to *S. aureus*, *P. aeruginosa*, resistant gram-negative bacilli, or *Candida*.

Empiric antibiotic treatment (Calderwood, 2023)

- When selecting an antibiotic, consider severity of illness, risk factors for infection, and likely pathogens associated with the specific intravascular device.
- Coagulase-negative *staphylococci* are the most common cause of catheter-related infections and most respond to vancomycin but are resistant to methicillin.
- Use daptomycin in institutions with high rates of infection due to methicillin-resistant *S. aureus*.
- With *S. aureus* bacteremia, perform a transesophageal echocardiogram (TEE) to rule out infective endocarditis (unless fever and bacteremia resolve within 72 hours after catheter removal and patient has no underlying cardiac conditions).
- In uncomplicated infection with negative blood cultures following catheter removal, duration of therapy is 10 to 14 days.
- In persistent bacteremia greater than 72 hours following catheter removal, duration of treatment is at least four to six weeks (coagulase-negative *staphylococcal* infection does not require prolonged therapy).
- Following device removal, administer antibiotic therapy for at least two to three days before new device replacement to avoid colonizing the new device.

- Monitor patients closely following therapy for relapses or signs of metastatic infection.
    - Repeat blood cultures after treatment is started to assess for resolving infection.
    - Positive blood cultures and/or persistent symptoms 72 hours after catheter removal with antibiotic therapy should prompt evaluation for other complications such as thrombophlebitis, endocarditis, and metastatic infection.

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