Preventing and Managing Central Line-Associated Bloodstream Infections

Central line-associated bloodstream infection (CLABSI) is a term used by the Centers for Disease Control and Prevention (CDC) for surveillance purposes and 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 (CDC, 2011). CLABSIs are costly, may increase length of stay, and are associated with a high mortality rate, ranging from 12 to 25% (Dumont & Nesselrodt, 2012).

Sources of catheter contamination include (Dumont & Nesselrodt, 2012):
- 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 fluid or medication infused into the catheter.

The CDC, Institute for Healthcare Improvement (IHI), and the Society for Healthcare Epidemiology of American (SHEA) recommend best practices for central line insertion and management. The IHI grouped these evidence-based practices into a “bundle,” that when implemented together, have proven successful in preventing CLABSI. The bundle includes five critical components:
- Select the best insertion site.
- Perform hand hygiene.
- Use maximal sterile barrier precautions.
- Prepare the insertion site with >0.5% chlorhexidine with alcohol.
- Promptly remove nonessential catheters.

Central Line Insertion and Management Checklist

Follow Proper Insertion Practices (CDC, 2011; Marschall et al., 2014)
- Select central venous catheter (CVC) based on the intended purpose and duration of use.
  - Use midline catheter or peripherally inserted central catheter (PICC) if therapy > 6 days.
  - Use CVCs with 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 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 either 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 (i.e. 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 >0.5% 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 < 2 months is unknown.
  - Allow antiseptics to dry according to manufacturer’s recommendation prior to skin puncture.
- Ultrasound guidance may be used by fully trained staff to avoid multiple attempts.
- Place a sterile gauze dressing or sterile, transparent, semipermeable dressing over the insertion site.
  - If patient is diaphoretic or bleeding at the site, use gauze until the site is dry.
- For patients 18 years or 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 patients younger than 18 years with short-term, non-tunneled central venous catheters:
  - For premature neonates, chlorhexidine-impregnated dressings are NOT recommended to protect the site due to risk of serious adverse skin reactions.
  - There is insufficient evidence to make any recommendation about the use of chlorhexidine-impregnated dressings for pediatric patients less than 18 years old and non-premature neonates.

Central Line Management (CDC, 2011; Marschall et al., 2014)
- Bathe ICU patients over 2 months of age with a chlorhexidine preparation daily.
- Scrub access port or hub with friction prior to 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 clean or sterile gloves.
- Change the dressing if it becomes loose, damp, or soiled.
- Change gauze dressings on short-term CVCs at least every 2 days.
- Change semipermeable dressings on short-term CVCs at least every 7 days.
- Monitor catheter sites visually when changing the dressing or by palpation through an intact dressing on a regular basis. 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 4 days, but at least every 7 days.
  - If blood, blood products, or fat emulsions are administered, 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 cover.

- 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 prior to 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 5 days.
- Consider using antiseptic impregnated caps for access ports.

**Education, Training, and Staffing (CDC, 2011; Marschall et al., 2014)**

- Educate healthcare personnel on indications for central lines, proper procedures for insertion and maintenance, and appropriate infection prevention measures.
- Periodically assess staff knowledge and compliance to guidelines of care.
• Allow only trained personnel to insert and care for peripheral and central intravascular catheters and ensure these clinicians undergo a credentialing process to confirm competency.
• Ensure proper nursing staff levels in intensive care units (ICUs), a minimum ratio of 1 nurse to 2 patients.
• Provide a checklist to clinicians to ensure adherence to aseptic insertion practices.
• Reeducate personnel at regular intervals on central line insertion, handling and maintenance, and policies, procedures, supplies, or equipment changes.
• Empower staff to stop non-emergent CVC insertion if aseptic technique is not maintained.
• Ensure efficient access to supplies for central line insertion and maintenance.
• Use hospital-specific or collaborative performance initiatives to improve compliance with recommended evidence-based practices.
• Perform surveillance for CLABSI and measure unit-specific incidence (CLABSI per 1,000 catheter-days).

Diagnosis (Band, 2018)
• If infection is suspected, notify the independent licensed practitioner (LIP) immediately.
  o 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 prior to antibiotic administration.
  o If blood cannot be drawn from a peripheral vein, blood may be drawn from different lumens of multi-lumen catheters (≥ 2 blood samples should be drawn from lumens at different times).
  o Blood cultures positive for Staphylococcus Aureus, coagulase-negative staphylococci, or Candida species in the absence of other sources of infection should increase the suspicion of catheter-related infection.
  o Catheter cultures should be performed when a catheter is removed for suspected infection.
• Laboratory confirmation of a catheter-related bloodstream infection requires one of the following criteria (Band, 2018):
  o Culture of the same organism from both the catheter tip and at least one percutaneous blood culture.
  o Culture of the same organism from at least two blood samples (one from the catheter hub and the other from a peripheral vein or second lumen).
• Once the infection is confirmed, the healthcare provider must determine if the catheter will be removed, salvaged, or exchanged.
  o Catheter should be removed in the following circumstances:
    ▪ Severe sepsis
    ▪ Hemodynamic instability
    ▪ Endocarditis or evidence of metastatic infection
    ▪ Erythema or exudate due to thrombophlebitis
    ▪ Persistent bacteremia after 72 hours of antimicrobial therapy
  o Benefit of catheter removal must be weighed against the difficulty in obtaining alternative venous access.
  o Long-term catheters (indwelling ≥ 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.
  o Catheters may be exchanged over a guidewire if the risk for mechanical complications or bleeding during catheter reinsertion is high.
• 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 for infections due to *S. aureus*, *P. aeruginosa*, resistant gram-negative bacilli, or *Candida*.

Empiric Antibiotic Treatment (Band, 2018)
• When selecting 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 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 > 72 hours following catheter removal, duration of treatment is at least 4 to 6 weeks (coagulase-negative staphylococcal infection does not require prolonged therapy).
• Following device removal, administer antibiotic therapy for at least 2 to 3 days prior to new device replacement.
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.

References:


