

Are Antimicrobial-Impregnated Central Venous Catheters Cost-Effective?

Abstract

Central venous catheters (CVCs) are an integral part of the management of critically and chronically ill patients. These devices are essential to the delivery of life-sustaining fluids such as total parenteral nutrition (TPN), lipids, blood, antibiotics, and pressors such as sodium nitroprusside, dopamine, and dobutamine HCl. CVCs are also used in the evaluation and treatment of critically ill patients and in the assessment and monitoring of their hemodynamic fluid status. Unfortunately, CVCs, the very devices needed to treat and manage these patients, often become potentially life-threatening devices because of their potential to cause catheter-related bloodstream infections (CR-BSIs). How can we prevent CR-BSIs? Evidence-based practice shows that a proactive approach to catheter-related infection not only saves money but also decreases morbidity and mortality in patients.

Identification of the Problem

Multiple studies have shown that CR-BSIs are a common risk for patients with CVCs.¹⁻² In order to reduce the risk of CR-BSIs, it is important to recognize the critical factors that influence the occurrence of this complication.

These include:

- **Catheter Site Selection.** The femoral area has a higher incidence of CR-BSIs than the subclavian and internal jugular vein sites.¹⁻²
- **Type of Barrier Precautions Used During Catheter Insertion.** The catheter must be placed using strict sterile technique, and with appropriate and effective skin antiseptics products.^{1,3}
- **Post-Insertion Management.** Management of the device will be impacted by the patient's hospital or homecare status.^{1,3} Every member of the healthcare team who will be caring for the patient's catheter must be educated in appropriate catheter care.^{1,3} All dressing changes and accessing of the catheter must be performed using strict sterile technique.^{1,3}
- **Multi-lumen Central Catheters vs. Single-lumen Catheters.** Single-lumen catheters have a lower incidence of infection.⁴
- **Preexisting Conditions.** The nurse should consider whether or not the patient had an infection prior to catheter insertion. Patients with preexisting infections have a higher incidence of CR-BSIs.⁵

- **Duration of Catheter.** The longer the catheter is in, the greater the chance that the catheter will cause infection.^{1,3}
- **Immunosuppressed Patients.** The more immunosuppressed the patient is, the greater the chance that the catheter will cause infection.^{1,3}

Pathogenesis: How Do Infections Grow?

Approximately 65% of CR-BSIs originate from skin flora, 30% from the catheter hub, and 5% from other miscellaneous routes. It is critical that nurses increase their understanding of the process of pathogenesis in CVCs.⁶⁻⁷ Following CVC insertion, a thrombin sheath begins to form on both the internal and external portion of the catheter. This sheath is made up of platelets, plasma, and tissue proteins such as albumin, fibrinogen, fibronectin, and laminin.⁸ The thrombin layer, which becomes sticky, promotes the adherence of microorganisms to the surface of the catheter.⁸ Common microbes that adhere to thrombin sheaths are *Staphylococcus aureus*, *coagulase-negative staphylococci*, and *Candida albicans*. *Staphylococcus aureus* binds strongly to fibronectin, fibrinogen, laminin, and thrombin, while *coagulase-negative staphylococci* binds with fibronectin.⁸

Staphylococci and *Candida* also produce a slimy material rich in exopolysaccharide, which creates a sticky biofilm. The biofilm promotes the adherence and survival of organisms on the surface of foreign devices and in the bloodstream.⁹⁻¹⁰ When a catheter becomes contaminated, the organisms will migrate along its surface and become embedded in the thrombin sheath, leading to the catheter's colonization. When colonization occurs, treatment becomes impossible because the organisms infecting the catheter are embedded in the biofilm and thrombin sheath. At this point, removal of the catheter and infusion of antibiotics are the only way to treat the infection. But this leads to another dilemma: strong antibiotics such as vancomycin are required to treat the infection. This means a new central catheter must be placed in the presence of an existing infection, which increases the risk for CR-BSIs.

Case Scenario

Day #1

- Catheter is inserted.
- Thrombin sheath begins to form.