Prevention of Vascular Catheter-Related Bloodstream Infections

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KEYWORDS

• Bloodstream infection • Intravascular catheter • Prevention • Bacteremia

KEY POINTS

- Catheter-related bloodstream infections (CRBSI) are responsible for substantial morbidity, mortality, and excess cost; many CRBSI are preventable using current knowledge and prevention techniques.
- Evidence-based, clinical practice–oriented strategies to prevent CRBSI include appropriate education, training, and staffing levels for providers; insertion of central venous catheters (CVC) using full sterile barriers, skin disinfection with chlorhexidine; avoidance of the femoral insertion site; use of a checklist; and combining interventions together in a bundle.
- After insertion, care of patients with CVCs should include maintenance of the dressing; scrub-the-hub aseptic technique when accessing the CVC; skin antisepsis with chlorhexidine; and removal of the CVC as soon as practical.
- Technologic innovations proven to reduce CRBSI include antiseptic/antimicrobial-coated CVCs; chlorhexidine-impregnated sponge or gel pad dressings; chlorhexidine patient bathing; passive disinfection of catheter hubs/connectors; and antimicrobial/antiseptic catheter locks.

INTRODUCTION AND CLINICAL SIGNIFICANCE

Reliable access to the vascular system is a necessity for the practice of medicine and enables the delivery of medications and fluids, ready sampling of the blood for diagnostic testing, and monitoring of a patient's clinical status. Unfortunately, vascular catheter-related infection is an all-too-common event that results in substantial morbidity, mortality, and excess cost. The Centers for Disease Control and Infection

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(CDC) estimates that approximately 72,000 central line–associated bloodstream infections (CLABSI) occur annually in the United States in intensive care units and dialysis units[1] and that these infections result in an attributable mortality of 12%, an extra 7 days of hospitalization per case, and excess costs of $45,000 per episode.[2,3]

In this monograph, an evidence-based approach to the prevention of vascular catheter infections is summarized. Both practice-based and technology-based prevention strategies are covered. Although central venous catheters (CVCs) are emphasized, considerations regarding arterial catheters, hemodialysis catheters, and peripheral intravascular catheters (PIVCs) also are included. In recent years, several comprehensive evidence-based guidelines regarding prevention of catheter-related bloodstream infection (CRBSI) have been published,[4–7] and it is not the intent to duplicate these guidelines here. Instead, the most critical issues are consolidated and summarized.

DEFINITIONS AND SURVEILLANCE

Unfortunately, the terms "central line–associated bloodstream infection" (CLABSI) and "catheter-related bloodstream infections" (CRBSI) are often used interchangeably. However, they have distinct meanings, with CRBSI being a clinical term that requires specific laboratory testing (catheter tip culture, quantitative blood cultures, or differential time-to-positivity testing from blood obtained from the implicated catheter and peripheral blood) in a patient who is bacteremic/fungemic to establish the source of infection, versus CLABSI, which is a surveillance term that is by design relatively sensitive but not as highly specific.

In recent years, great strides have been made in understanding the pathogenesis of CRBSI, as well as the implementation of effective preventive interventions. There is a growing realization that many, if not most, episodes of CRBSI can be prevented. The increasing expectation for prevention and the large additional costs associated with health care–associated infections has captured the attention of governmental agencies and third party payers. Hospitals have come under intense scrutiny and a variety of measures have been implemented to encourage prevention of CRBSI, such as mandatory public reporting and economic penalties. However, the CDC NHSN definition of CLABSI was intended as a surveillance tool to drive performance improvement. The CLABSI definition overestimates the true incidence of infection, lacks specificity, and, despite recent improvements, remains somewhat subjective (in assigning the source of infection).[8–10] Further undermining the validity of the surveillance data, most institutions acknowledge use of an adjudication approach in defining CLABSI.[11] Clearly, modifications can be made in the surveillance definition to improve specificity and risk-stratify data. A robust data validation program should be in place to ensure accurate reporting and to discourage systematic underreporting. Surveillance systems should be expanded into non–acute care settings (eg, infusion centers, home care, long-term care)[12] and should include other intravascular catheters (arterial catheters, midline catheters, and PIVC).

PATHOGENESIS

Fig. 1 illustrates the 4 routes by which microbes gain access to a vascular catheter. For short-term, nontunneled catheters, the primary route of inoculation and infection is via the dermal surface: microbes that are resident on the skin colonize the catheter at the interface between the skin and the catheter. For tunneled catheters, and the longer a temporary nontunneled catheter remains in place, the hub and luminal surface become increasingly implicated as the major route of colonization and infection. Rarely do catheters become infected via hematogenous seeding and, with