

## Prevention of Central Venous Catheter-related Infections

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The central venous catheter is a valuable tool in inpatient medicine. However, with its use comes the risk of local and systemic infections. Kluger et al estimated that 250,000 cases of central line-associated blood stream infections occur annually. Mortality rates range from 12-25% per infection.<sup>1</sup> Therefore, it is essential that health care providers take all necessary precautionary measures to avoid infection. Guidelines have been published by the Centers for Disease Control and Prevention to provide an evidence-based medicine (EBM) approach for avoiding central venous catheter-related infections. Recommendations include proper skin cleansing, the use of maximal sterile barriers, selection of the subclavian site, avoiding routine replacement of central venous catheters, and using antiseptic/antibiotic impregnated catheters.

Aseptic technique is the first step in infection prevention. The patient's skin must be properly disinfected, prior to the insertion of any venous catheter. Typically, povidone iodine is used for skin antisepsis. However, Maki et al demonstrated a lower incidence of bacteremia with the use of 2% chlorhexidine gluconate, versus 10% povidone-iodine or 70% alcohol (0.5 versus 2.3 and 2.6 per 100 catheters, respectively).<sup>2</sup> Furthermore, Chaiyakunapruk et al performed a meta-analysis which showed a 50% overall reduction in catheter-related blood stream infections with the use of chlorhexidine.<sup>3</sup>

Once the skin has been properly disinfected, the practitioner must take additional measures to maintain sterile conditions. The use of sterile gloves and drapes alone are not enough. A study done in 1994 by Raad et al showed that using maximal sterile barrier precautions (a cap, gown, sterile gown, sterile gloves and a large sterile drape) substantially reduced catheter-related bloodstream infections, as opposed to standard precautions with only sterile gloves and small drapes.<sup>4</sup>

The site of the central venous catheter has also been linked to infection. Collignon et al found that the lowest rate of catheter colonization occurred with placement at the subclavian site, and the highest rate with catheters at the femoral site (15% vs 34%, respectively).<sup>5</sup> Femoral catheters have also been associated with a higher risk for deep venous thrombosis (DVT). Therefore, from an EBM standpoint, the subclavian vein is the preferred site

of insertion for infection control purposes. Note that all factors must be taken into account when selecting a catheter site in a given patient, including operator skill, the potential for mechanical complication, patient comfort, anatomic variables, and bleeding diatheses.

Once the central venous catheter has been placed using proper aseptic technique, it should not be changed on a scheduled basis. Cobb et al conducted a randomized controlled trial where 160 patients underwent one of four methods of catheter exchange: replacement every three days by insertion at a new site (group 1); exchange over a guidewire every three days (group 2); replacement when clinically indicated by insertion at a new site (group 3); exchange over a guidewire when clinically indicated (group 4). The incidence rates of bloodstream infection per 1000 days of catheter use were 3 in group 1, 6 in group 2, 2 in group 3, and 3 in group 4. Therefore careful clinical inspection of that catheter site at least every other day is recommended versus prophylactic changes of catheter site.<sup>6</sup> The exception to this is the Swan-Ganz catheter, which should be removed within 3-5 days and replaced at a new site if further monitoring is required. When changing a central venous catheter is clinically indicated, options include changing over a guidewire or insertion at a new site. For infection control purposes, placement at a clean site is preferred. However, this method is associated with a greater incidence of mechanical complications.

Lastly, the type of catheter used has been shown to affect the rate of infection. There is a higher incidence of infectious complications with multi-lumen catheters. Studies have also been done with antiseptic and antibiotic impregnated catheters. A meta-analysis by Veenstra et al showed a decrease in catheter colonization and catheter-related bloodstream infections with chlorhexidine/silver sulfadiazine-impregnated catheters, versus non-impregnated catheters.<sup>7</sup> Reductions in bacteremia have also been noted with minocycline/rifampin-impregnated catheters.<sup>8</sup> The chlorhexidine/silver sulfadiazine impregnated catheters were also more cost effective.<sup>9</sup> Currently, the CDC recommends implementing a comprehensive strategy to lower the incidence of catheter related bloodstream

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infections (CRBSI), including education of practitioners, use of maximal barrier protection, and 2% chlorhexidine for skin antiseptics. If the CRBSI rate remains above the institutions goal despite these measures, then antibiotic/antiseptic impregnated catheters should be used in adult patients in whom the central venous catheter is expected to remain in place for >5 days.

Central venous catheter infections remain a prevalent problem in inpatient medicine. While risk of infection is always present with indwelling lines, measures can be taken to minimize this potentially fatal complication. Proper aseptic technique with thorough skin preparation and maximal barrier precautions, careful site selection, and diligent clinical inspection of a catheter site can drastically reduce infection risk and improve patient care.

### Reference

1. Kluger, DM, Maki, DG. The relative risk of intravascular device related bloodstream infections in adults [abstract]. In: Abstracts of the 39th Interscience Conference on Antimicrobial Agents and Chemotherapy. San Francisco, CA: American Society for Microbiology 1999:514.
2. Maki, DG, Ringer, M, Alvaro, CJ. Prospective randomized trial of povidone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheters. *Lancet* 1991; 338:339.
3. Chaiyakunapruk, N et al. Chlorhexidine compared with povidone-iodine solution for vascular catheter-site care: A meta-analysis. *Ann Intern Med* 2002; 136:792
4. Raad, II et al. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. *Infection Control Hospital Epidemiology* 1994; 15:231.