

What is the evidence for intraluminal colonization of hemodialysis catheters?

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Hemodialysis catheter-related bloodstream infections are potentially devastating, leading to increased morbidity, mortality, and cost of care. Prospective studies published over the past 15 years shed light on the pathogenesis of these infections. The data suggest that the intraluminal microbial colonization of hemodialysis catheters often precedes bloodstream infection. This finding supports strategies aimed at preventing or eradicating intraluminal colonization.

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During the initial stages of intravascular catheter colonization, a biofilm is formed that is made up of host proteins and microbes (Figure 1). Bacteria and fungi survive and proliferate within the biofilm, despite host immune defenses and therapeutic doses of antimicrobial agents.^{1–3} Catheter-related bloodstream infections (CRBSIs) most commonly emanate from microorganisms colonizing the catheter insertion site migrating distally along the extraluminal surface of the catheter into the bloodstream or from microorganisms that migrate intraluminally into the bloodstream from a colonized catheter hub, connector, or less often from microorganisms in contaminated infusate.⁴ Some investigators found that when hemodialysis catheters were routinely removed 1 month after insertion, all of the catheters had intraluminal surface biofilm and ‘ultrastructural colonization’ detected using scanning electron microscopy.⁵ Other investigators have identified bacteria within the biofilm on the luminal surface of hemodialysis catheters using scanning electron microscopy.⁶ On the other hand, another study found that the outer surface of hemodialysis catheters removed after 138 ± 141 days in bacteremic patients had a thicker biofilm and more microbial colonization than the luminal catheter surface.⁷ In addition, thicker biofilm on hemodialysis catheters has been associated with positive blood cultures drawn through the catheter compared with those with negative blood cultures drawn through the catheter.⁸ Eventually, planktonic bacteria or fungi break off from the biofilm and seed the bloodstream, causing bacteremia or fungemia, which may lead to metastatic infection.^{9–11} Both intraluminal and extraluminal colonization of hemodialysis catheters are important sources of microbes leading to CRBSI. An intraluminal source may be especially important in those patients with tunneled, cuffed, long-term hemodialysis catheters. This mini review focuses on intraluminal colonization.

In a seminal prospective study,¹² 13 patients undergoing hemodialysis through central venous catheters developed fever and rigors, 12 of whom had catheter colonization and positive percutaneously drawn blood cultures. Of these 13 patients, their infection emanated from the catheter insertion site, catheter lumen, or both sites in three, eight, and two patients, respectively, suggesting a predominant intraluminal source of infection. Studies of patients receiving hemodialysis

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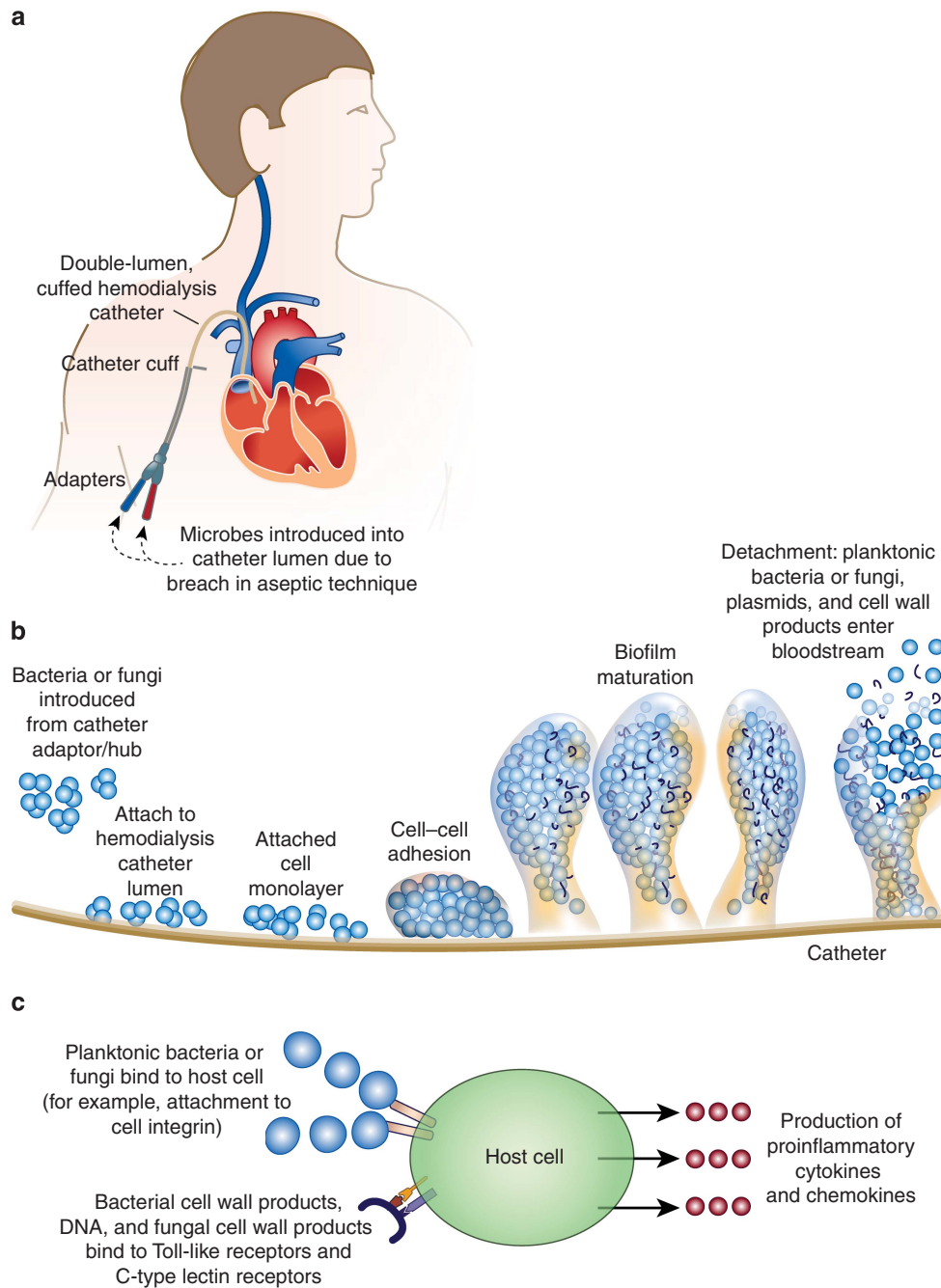


Figure 1 | Intraluminal colonization of hemodialysis catheters.

through central venous catheters have clearly demonstrated that the catheter lumens often become colonized over time, and in many such cases the same bacteria or fungi can be isolated from percutaneously drawn blood cultures weeks later (Table 1). In another study,¹³ investigators performed catheter-drawn blood cultures weekly for 3 weeks just before dialysis. For 15 of 21 patients, catheter-drawn and percutaneously drawn blood cultures grew the same microorganism. All 15 patients were initially asymptomatic and afebrile during dialysis. Eight of the 15 patients subsequently developed evidence of infection manifested by

fever and rigors, and in each case the same Gram-positive or Gram-negative microorganism was grown from cultures of the hemodialysis catheter hub, and from catheter-drawn and percutaneously drawn blood cultures. This investigation suggested that patients receiving hemodialysis through catheters may develop intraluminal colonization from a colonized catheter hub, leading to bacteremia, which may occur without associated signs or symptoms. These investigators performed another study in which weekly catheter-drawn blood cultures were obtained from 28 hemodialysis patients just before dialysis.¹⁴ When a

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