Central Line-Associated Blood Stream Infection (CLABSI)

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Introduction
Vascular access devices are commonly used in the hospital setting to administer fluids, medications, parenteral nutrition and blood products, to provide access for hemodialysis, and to monitor critically ill patients [1]. Central lines are vascular access devices that terminate at or close to the heart, or in one of the great vessels [2]. Infection is a recognized potential complication of central line use. Central line infections can be divided up into local infections (exit site infection, tunnel infection, pocket infection) which may or may not be associated with bacteremia, and central line-associated bloodstream infection (CLABSI) [3]. The epidemiology, pathogenesis, microbiology, and laboratory diagnosis of CLABSI will be briefly reviewed here.

Definition/Epidemiology
CLABSI is typically defined as a laboratory confirmed bloodstream infection (recognized pathogen from at least one blood culture or skin commensal from two or more blood cultures) in a patient who has a central line at the time of bacteremia or within 1 day prior and no other clear focus of infection [2]. Patients with CLABSI may present with systemic symptoms and signs of infection, including fever, chills, and hypotension [1,3]. Associated signs of local infection, including erythema, swelling, tenderness, and drainage at the catheter exit site may or may not be present [3]. In the United States, there were an estimated 18,000 episodes of CLABSI among patients admitted to intensive care units and 23,000 episodes among patients on inpatient wards in 2009 [4].

Pathogenesis
CLABSI most commonly occurs either via the extraluminal migration of organisms secondary to colonization along the external surface of the catheter, or via the intra-luminal migration secondary to colonization of the catheter hub. Extra-luminal spread of micro-organisms is more common for short term catheters (present for <14 days), while intra-luminal spread leading to CLABSI becomes more important with long term catheters (present for ≥14 days). CLABSI may also occur secondary to hematogenous seeding of the vascular access device from a distant focus of infection or from the infusion of contaminated infusate, but both of these mechanisms are much less common.

Microbiology
Not unexpectedly, CLABSI is often caused by a member of the normal skin flora [5,6]. Coagulase-negative staphylococci (e.g., Staphylococcus epidermidis) represent the most frequently recovered pathogens in cases of CLABSI [1,5,6]. However, CLABSI may also be caused by many other micro-organisms including gram-positive bacteria such as Staphylococcus aureus and Enterococcus spp., gram-negative bacteria such as Pseudomonas aeruginosa and members of the family Enterobacteriaceae (e.g., Escherichia coli), and yeast [5,6].

Diagnosis
When investigating a patient for possible CLABSI, paired blood samples drawn through a peripheral vein and the vascular catheter should be obtained [1]. Blood for culture should always be collected prior to the initiation of antimicrobial therapy [1]. Collection of blood for culture from both a peripheral site and at least one lumen of the central line is important for allowing differentiation of true CLABSI from contamination, particularly when a member of the normal skin flora is recovered. Note that for adult patients, there may be value to obtaining blood from each lumen of a multi-lumen vascular catheter in addition to a peripheral sample. In a recent publication, failing to culture both lumens of a double lumen line would have resulted in 27.2% of CLABSI episodes being missed [7].

Diagnosis of CLABSI may be supported by the catheter drawn blood culture becoming positive at least 2 hours before a simultaneously drawn peripheral blood culture (differential time-to-positivity) [Table 1] [1,3]. When bacteremia arises from a vascular catheter, the concentration of organisms in a blood sample drawn through the infected lumen will be greater than the concentration of organisms in a peripheral sample collected at the same time. The catheter drawn sample will often go positive prior to the peripheral sample, related to the higher initial concentration of bacteria [1,3]. Diagnosis of CLABSI may also be supported by demonstration of catheter colonization with the same organism that is recovered in the bloodstream [Table 1] [1,3]. When a vascular catheter is removed, the tip may be submitted to the microbiology laboratory for culture. The skin should be cleansed around the vascular catheter exit site with 70% alcohol prior to removal. The catheter should then be aseptically removed, and the distal 5 cm submitted in a
sterile, screw capped container. In the microbiology laboratory, the tip is rolled over the surface of a blood agar plate [Figure 1]. The plate is then incubated at 35°C for 24 hours. Recovery of ≥15 colonies of a micro-organism indicates colonization of the catheter, and supports the catheter as a source of bacteremia if the same organism has been recovered on blood culture [1,3]. When present, catheter exit site exudate should also be swabbed and submitted to the microbiology laboratory for Gram stain and culture [1].

**Therapy**

A detailed discussion on the treatment of CLABSI is beyond the scope of this brief review. In general, selection of antimicrobial therapy should take into account the most likely pathogens to be encountered, as well as the site of the catheter, severity of infection, and patient co-morbidities [1]. Definitive treatment recommendations vary depending on the pathogen recovered, severity of illness, presence or absence of associated local infection, presence or absence of complications (e.g., endocarditis, septic thrombophlebitis), and patient factors, including ongoing need for central venous access [1]. For current recommendations on the treatment of CLABSI, the reader is referred to the Infectious Diseases Society of America Clinical Practice Guidelines for the Diagnosis and Management Catheter Related Infection, available online at: [http://www.idsociety.org/IDSA_Practice_Guidelines/](http://www.idsociety.org/IDSA_Practice_Guidelines/).

**Take Home Points**

- CLABSI is a recognized potential complication of central line use.
- For diagnosis of CLABSI in adult patients, obtain blood cultures simultaneously from a peripheral site and at least one lumen of the central line. A single line drawn blood culture is not appropriate.
- Diagnosis of CLABSI is supported by a blood culture drawn through a central line becoming positive at least 2 hours prior to a simultaneously collected peripheral blood culture.
- Recovery of ≥15 colonies of a micro-organism on a central line tip that has been removed supports the line as a source of bacteremia if the same organism was isolated in the blood.

![Figure 1.](image)

Semiquantitative central line tip culture, roll plate method – The distal 5 cm of an aseptically removed catheter is rolled on a blood agar plate. The plate is then incubated for 24 hours. Recovery of ≥15 colonies of a micro-organism supports the line as a source of bacteremia if the same organism was isolated in the blood.

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<th>Table 1. Diagnostic techniques currently available at Diagnostic Services Manitoba (DSM) Microbiology Laboratories to support a diagnosis of central-line associated bloodstream infection (CLABSI) [3]</th>
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