



Diagnosis of Catheter-Related Bloodstream Infection (CRBSI)

Central Venous Catheter Care Bundle
Workshop

Langkawi

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Definitions of intravascular catheter–related infections

Infection	Definition
Catheter colonization	Significant growth of a microorganism in a quantitative or semiquantitative culture of the catheter tip, subcutaneous catheter segment, or catheter hub (see the Diagnosis section)
Phlebitis	Induration or erythema, warmth, and pain or tenderness around catheter exit site

Definitions of intravascular catheter–related infections

Exit-site infection

Microbiological

Exudate at catheter exit site yields a microorganism with or without concomitant bloodstream infection

Clinical

Erythema, induration, and/or tenderness within 2 cm of the catheter exit site; may be associated with other signs and symptoms of infection, such as fever or pus emerging from the exit site, with or without concomitant bloodstream infection^a

Definitions of intravascular catheter–related infections

- Tunnel infection** Tenderness, erythema, and/or induration >2 cm from the catheter exit site, along the subcutaneous tract of a tunneled catheter (e.g., Hickman or Broviac catheter), with or without concomitant bloodstream infection^a
- Pocket infection** Infected fluid in the subcutaneous pocket of a totally implanted intravascular device; often associated with tenderness, erythema, and/or induration over the pocket; spontaneous rupture and drainage, or necrosis of the overlying skin, with or without concomitant bloodstream infection, may also occur^a

Definitions of intravascular catheter–related infections

Bloodstream infection

Infusate related

Concordant growth of the same organism from infusate and cultures of percutaneously obtained blood samples with no other identifiable source of infection

Catheter related

Bacteremia or fungemia in a patient who has an intravascular device and ≥ 1 positive result of culture of blood samples obtained from the peripheral vein, clinical manifestations of infection (e.g., fever, chills, and/or hypotension), and no apparent source for bloodstream infection (with the exception of the catheter). One of the following should be present: a positive result of semiquantitative (≥ 15 cfu per catheter segment) or quantitative ($\geq 10^2$ cfu per catheter segment) catheter culture, whereby the same organism (species and antibiogram) is isolated from a catheter segment and a peripheral blood sample; simultaneous quantitative cultures of blood samples with a ratio of $\geq 5:1$ (CVC vs. peripheral); differential time to positivity (i.e., a positive result of culture from a CVC is obtained at least 2 h earlier than is a positive result of culture from peripheral blood)

Definition of Catheter-Related Bloodstream Infection (CRBSI)

- Presence of an intravascular device
- Clinical evidence of infection (fever, chills, and/or hypotension) and no apparent source for infection (except the catheter)

Definition of Catheter-Related Bloodstream Infection (CRBSI)

- Positive culture of blood from peripheral vein and one of the following
 - a positive result of catheter culture semiquantitative (≥ 15 cfu per catheter segment) or quantitative (10^2 cfu) of the same organism (species and antibiogram)
 - a positive culture of blood drawn from CVC quantitative at ratio of 5:1 (CVC vs. peripheral) or differential time to positivity (i.e. positive result of culture from CVC is obtained at least 2 h earlier than is a positive result of culture from peripheral blood)

Catheter-related bloodstream infection (CRBSI)

- In the absence of laboratory confirmation, defervescence after removal of an implicated catheter from a patient with bloodstream infection may be considered indirect evidence of CRBSI
- Clinical findings alone are unreliable for establishing a diagnosis of CRBSI

Catheter-related bloodstream infection

- By NNIS

Presence of a recognized pathogen cultured from one or more blood cultures and
Organism cultured from blood not related to infection at another site

or

Presence of at least one of the following:
Fever (temperature, $>38^{\circ}\text{C}$)
Chills
Hypotension

and

Signs and symptoms and positive results not related to infection at another site and

Presence of at least one of the following:

Common skin contaminant (e.g., diphtheroids, bacillus species, propionibacterium species, coagulase-negative staphylococci or micrococci) cultured from two or more blood samples drawn on separate occasions

Common skin contaminant cultured from at least one blood culture in a sample from a patient with an intravascular catheter

Positive antigen test on blood (e.g., *Haemophilus influenzae*, *Streptococcus pneumoniae*, *Neisseria meningitidis*, or group B streptococcus)

Diagnosis of CRBSI

- Catheter removed
 - semiquantitative culture of catheter segment
 - quantitative culture of catheter segment
- Catheter maintained
 - quantitative paired blood cultures
 - differential time to positivity of paired blood cultures

Diagnosis of CRBSI

- Catheter removal required
 - (i) Semi-quantitative culture method
 - catheter segment is rolled across surface of an agar plate and cfu are counted after overnight incubation
 - >15 cfu is significant
 - limitation: cultures organisms from the external surface of the catheter
 - intraluminal colonisation, after prolonged and excessive use of the catheter hub not evaluated

Diagnosis of CRBSI

- Catheter removal required
 - (ii) **Quantitative culture method**
 - culture of the catheter segment requires either flushing the segment with broth, or vortexing, or sonication in broth, followed by serial dilutions and surface plating on blood agar
 - can isolate organisms from internal and external surfaces of catheters
 - $> 10^2$ cfu is significant

Diagnosis of CRBSI

- Problems associated with catheter segment diagnostics:
 - needless removal of uninfected catheters
 - potential inhibitory effect of antimicrobial impregnated catheters on catheter cultures

Diagnosis of CRBSI

- Catheter maintained
 - Paired blood culture from lumen of CVC and peripheral vein
 - either
 - (i) quantitative culture
 - (ii) differential time to positivity
 - culture same organism with same antibiogram

Diagnosis of CRBSI

- Catheter maintained

- Endoluminal brush technique

- wire brush is used to culture the endoluminal surface in situ
 - then blood drawn through CVC is Gram or acridine orange stained
 - sensitivity >90% , specificity 84%
 - risks of transient bacteremia, cardiac arrhythmias and embolisation

Diagnosis of CRBSI

- Quantitative blood culture
 - CVC : peripheral blood culture cfu ratio of 5:1
 - not done in most laboratories
 - long turn-around time (48-72 hours)

Diagnosis of CRBSI

- Differential time to positivity
 - difference in time to growth of cultures drawn through the CVC and peripheral vein
 - positive result of culture of blood from the CVC at least 2 h earlier than the positive result of a peripheral blood culture
 - sensitivity 94%, specificity 91%
 - automatic devices for blood cultures

Diagnosis of CRBSI

- Differential time to positivity
 - early studies indicated utility primarily in immunocompromised patients with long-term or tunneled catheters
 - recent published study indicated utility in patients with both short (< 30 days) and long-term catheters
 - sensitivity was lower in short-term catheters and specificity was lower in long-term catheters