Diagnosis of Catheter-Related Bloodstream Infection (CRBSI)

Central Venous Catheter Care Bundle Workshop
Langkawi
14 - 16th April 2008
## Definitions of intravascular catheter–related infections

<table>
<thead>
<tr>
<th>Infection</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Catheter colonization</td>
<td>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)</td>
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<tr>
<td>Phlebitis</td>
<td>Induration or erythema, warmth, and pain or tenderness around catheter exit site</td>
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Definitions of intravascular catheter–related infections

<table>
<thead>
<tr>
<th>Exit-site infection</th>
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<tbody>
<tr>
<td>Microbiological</td>
<td>Exudate at catheter exit site yields a microorganism with or without concomitant bloodstream infection</td>
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<tr>
<td>Clinical</td>
<td>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</td>
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Mermel LA et al. Management Guidelines for Catheter Infections • CID 2001:32; 1249-72
<table>
<thead>
<tr>
<th>Definition</th>
<th>Description</th>
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<tbody>
<tr>
<td>Tunnel infection</td>
<td>Tenderness, erythema, and/or induration &gt;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 infection³</td>
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<tr>
<td>Pocket infection</td>
<td>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 occur³</td>
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<td>Definitions of intravascular catheter–related infections</td>
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<tr>
<td><strong>Bloodstream infection</strong></td>
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<tr>
<td>Infusate related</td>
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<tr>
<td>Concordant growth of the same organism from infusate and cultures of percutaneously obtained blood samples with no other identifiable source of infection</td>
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<tr>
<td>Catheter related</td>
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<tr>
<td>Bacteremia or fungemia in a patient who has an intravascular device and $\geq 1$ 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 ($\geq 15$ 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).</td>
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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)

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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 ($\geq 15$ 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°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 uninfection 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