Catheter-related infections: practical aspects in 2003

A joint meeting of the Société Belge d'Infectiologie et de Microbiologie Clinique / Belgische Vereniging voor Infectiologie en Klinische Microbiologie (21st meeting) and the Groupement pour le Dépistage, l'Etude et la Prévention des Infections Hospitalières / Group ter Opsporing, Studie en Preventie van Infecties in de Ziekenhuizen

Thursday 20th November 2003

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Catheter-Related Infections

Belgian Epidemiological Data

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Introduction

- Major role of catheters in modern medicine
- Major cause of morbidity & mortality
  - Multiple infectious complications
    - Local site infections
    - Systemic infections
      - bacteremia/fungemia, sepsis
    - Infective endocarditis
    - Septic thrombo-phlebitis
    - Other metastatic infections
Incidence of catheter-related infections (CRI)

- Considerable variations by
  - Catheter-related parameters
    - Type, site of insertion, duration in situ
  - Frequency of manipulations
  - Patient-related parameters
  - Hospital size, hospital service/unit

- Major source of confusion
  - Inconsistent use of terms and definitions
  - Lack of standard definitions

- Diagnosis of CR-BSI (Blood Stream Infection) still problematic
Catheter-related infections: Examples of definitions

- **Catheter exit-site infection**
  - Erythema or induration within 2 cm of the catheter exit site, in the absence of concomitant bloodstream infection
    - Without concomitant purulence (CDC, 2002)
    - In combination with a positive culture from the skin and/or pus at the insertion site (Polderman, 2002)

- **Significant catheter colonization**
  - Significant growth of a microorganism from the catheter tip, or subcutaneous segment of the catheter
    - >15 CFU, « roll-plate » semiquantitative culture method
    - >10^3 CFU, by quantitative culture method
Catheter-related infections: Examples of definitions

- **CR-BSI**
  - Clinical manifestations of infection and no apparent source except the catheter
    - *in combination with*
  - Same organism (species and antibiogram) isolated from a (semi)quantitative culture of the catheter segment, and from a peripheral blood culture or from a paired « quantitative » blood culture (peripheral and catheter)

- **Probable CR-BSI**
  - In the absence of laboratory confirmation, normalisation of T° after removal of the implicated catheter (present for >48 h) from a patient with a BSI and without clear focus of infection at other site
Rate of CR-BSIs

- **Number of CR-BSIs per 1,000 catheter-days (CDC 2002)**

  *More useful than*

- **Number of CR-BSIs per 100 catheters**

  *Accounts for BSIs overtime*
  - Adjusts risk for the No of days the catheter is in use
  - Logistic problems to collect data!

<table>
<thead>
<tr>
<th>Type of ICU</th>
<th>CVC related BSI/1,000 cath days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary</td>
<td>4.5</td>
</tr>
<tr>
<td>Cardiothoracic</td>
<td>2.9</td>
</tr>
<tr>
<td>Medical</td>
<td>5.9</td>
</tr>
<tr>
<td>Neurosurgical</td>
<td>4.7</td>
</tr>
<tr>
<td>High risk nursery</td>
<td></td>
</tr>
<tr>
<td>&lt; 1,000 g</td>
<td>11.3</td>
</tr>
<tr>
<td>1,001–1,500 g</td>
<td>6.9</td>
</tr>
<tr>
<td>1,501–2,500 g</td>
<td>4.0</td>
</tr>
<tr>
<td>2,500 g</td>
<td>3.8</td>
</tr>
<tr>
<td>Etc.</td>
<td></td>
</tr>
</tbody>
</table>

*NNISS data to be used as benchmarks by individual hospitals for rate comparison (CDC)*
Type of catheter and rates of CR-BSIs

based on 206 published prospective studies, M.K. Schinabeck, Clin Microbiol Newsletter 2003

<table>
<thead>
<tr>
<th>Type of Catheter</th>
<th>No. of CR-BSI /100 catheters</th>
<th>/1,000 cath-days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral Venous C</td>
<td>0.2</td>
<td>0.6</td>
</tr>
<tr>
<td>Arterial C</td>
<td>1.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Central Venous C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>non-tunneled</td>
<td>3.3</td>
<td>2.3</td>
</tr>
<tr>
<td>tunneled</td>
<td>20.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Pulmonary artery C</td>
<td>1.9</td>
<td>5.5</td>
</tr>
<tr>
<td>Totally implantable C</td>
<td>5.1</td>
<td>0.2</td>
</tr>
</tbody>
</table>
### Type of catheter and rates of CRI

(BSI, M.K. Schinabeck, Clin Microbiol Newsletter 2003 and Local or BSI, CHU Lg)

<table>
<thead>
<tr>
<th>Type of Catheter</th>
<th>No. of CR-BSI /100 catheters</th>
<th>No. of CRI (Lg) /100 catheters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral Venous C</td>
<td>0.2</td>
<td>0.17</td>
</tr>
<tr>
<td>Arterial C</td>
<td>1.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Central Venous C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>non-tunneled</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>tunneled</td>
<td>20.9</td>
<td></td>
</tr>
</tbody>
</table>
Belgian Data

- **National Surveillance of Hospital Infections (NSIH) / ISP**
  - **Nosocomial Septicemia (> 48h post-admission)**
    - Year 2002 data
    - Available denominators:
      - No. of admissions
      - No. of patient-days
  - > 1 participation: 145 hospitals (80 % of Belgian H)
  - > 3 participations: +/- 70 hospitals
Data from CHU of Liège

Based on a retrospective review of laboratory results

- **Period** November 2002–October 2003
- **Culture of catheter if suspicion of CRI**
- **Colonized Catheters**
  - Positive “Roll plate” culture with > 15 CFU
  - No. = 525; Mean: 1.9 /Positive patient (1-17)
- **Patients (No. = 95 episodes) with the same organism cultured concomittantly from blood and from catheter**
- **No denominator !!**
# Type of catheter and rates of CR-BSIs

1992–2003 (& 2002), NSIH, ISP Belgium

<table>
<thead>
<tr>
<th>Type of Catheter</th>
<th>% of CR-BSI / Nosocomial BSI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Probable</td>
</tr>
<tr>
<td>Catheter-related</td>
<td></td>
</tr>
<tr>
<td>Central C</td>
<td>8.1 (7.2)</td>
</tr>
<tr>
<td>Peripheral C</td>
<td>1.6 (1.4)</td>
</tr>
<tr>
<td>Arterial C</td>
<td>0.3 (0.3)</td>
</tr>
<tr>
<td>Total No of Nosocomial BSI</td>
<td></td>
</tr>
</tbody>
</table>

(septicemia > 48 h)

(1.7/10,000 pt-days)
Distribution of microorganisms in "nosocomial" BSI (Belgium - USA)

<table>
<thead>
<tr>
<th>Category</th>
<th>Gram Positive</th>
<th>Gram Negative</th>
<th>Yeast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram pos</td>
<td>NSIH 92-03</td>
<td>NSIH 02</td>
<td>NNISS 92-99 (US)</td>
</tr>
<tr>
<td>CNS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enterococci</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other G+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other G+ neg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enterob.sp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. aeruginosa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other NFGNB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candida</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Distribution of microorganisms in CR-BSI & Nosocomial BSI (Belgium)

**Gram Positive**
- CNS
- Enterococci
- SA
- Other G+
- Gram neg
- Other entb
- Enterobacter sp
- P. aeruginosa
- Other NFGNB
- Candida

**Gram Negative**

**Yeast**

Legend:
- NSIH noso BSI
- NSIH 92-03 CRBSI
- NSIH 02 CRBSI
Distribution of microorganisms in CR-BSI (Chu Lg & Belgium)

Gram Positive

Gram Negative

Yeast

pm-chu lg 03
Colonized Catheter & Bloodstream Infection

Quantitative or semiquantitative culture of a catheter segment

- **Positive Catheter**
  - Risk Factor for BSI
  - About 20-30% lead to CR-BSI confirmed by microbiology

- **Negative Catheter**
  - Does not exclude a clinical CR-BSI
Microbial profile (in %) of CRI (CHU Lg)

Local I (colonized C.)

BSI

-60 -50 -40 -30 -20 -10 0 0 10 20 30 40 50 60%

Other Ca
Candida
NF GNB
P.aeruginosa
Other Ent
Enterobacter
Gram Neg
Other Gram
S.aureus
S.epidermidis
Gram Pos
Risk factors for CRI Related to the patient

- Age (< 1 or > 60)
- Distant infectious focus
- Neutropenia
- Immuno-suppressive therapy (except corticosteroids)
- Malignancy
- Previous or concommittant bacteremia
- Birth weight <1,500 g (neonates)
- Severity of underlying diseases
- Burns and extensive wounds
Risk factors for CRI
Related to the catheter and care

- Catheter types and materials
- Insertion site
  - Risk Femoral > jugular > subclavian vein
  - // density of skin colonisation
- Indwelling time
  - < 3 days, RF: +/- zero
  - 3-7 days, RF ↑ 3-5 % and > 7 days, RF ↑ 5-10 %
- Parenteral feeding
- Care and maintenance
- Dressing, etc.
Risk factors for CRI Related to hospital, unit

- Insertion procedure
  - Sub-optimal asepsis
  - Operator’s experience
- Emergency
- Time from admission
- Intensive Care Unit
Type of colonized catheters per care unit (CHU Liège)
Distribution of bacteria colonizing catheters per care unit (CHU Liège)

![Graph showing distribution of bacteria colonizing catheters per care unit.](image)
Distribution of bacteria colonizing catheters per type of catheter

(CHA Liège)

S. aureus
Other

P. aeruginosa
Enterobacter
Other

% Arterial Central Peripheric

% Arterial Central Peripheric
Virulence of multi-resistant bacteria ???

* * aureus, MRSA and CRI *

<table>
<thead>
<tr>
<th>Type of infection</th>
<th>% of MRSA</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. aureus</em> bacteremia</td>
<td>39.7</td>
</tr>
<tr>
<td><em>S. aureus</em> Positive catheters</td>
<td>55</td>
</tr>
<tr>
<td><em>S. aureus</em> CR-BSI</td>
<td>40.7</td>
</tr>
<tr>
<td>(36 % of all SA bacteremia)</td>
<td></td>
</tr>
<tr>
<td>(CHU Lg)</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

- RF for CRI
  - Great variability
- Basic problems for accurate comparisons
  - Local/systemic CRI
    - Clinical criteria/Microbiological results
  - Parameter to express rate of infections
  - Diagnostic procedures
    - Sub-optimal
  - Human and informatics resources
- Illustration of pitfalls if no clear cut definitions and correct denominators
- Usefulness of retrospective or prospective analysis
  - Quality improvement process