Complications of Central Venous Catheters

Treatment of Central Venous Catheters Complications

Marek Pertkiewicz (Poland)
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Marek Pertkiewicz
Dept. of General Surgery and Clinical Nutrition.
Medical University of Warsaw, Poland.

Polish Society of Parenteral and Enteral Nutrition

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Outline

- Pathophysiology of catheter related infection
- Treatment of catheter related infection
  - short term catheters
  - permanent catheters
- Management of catheter related thrombosis
Complications of venous access

- Early - associated with insertion
  - pneumothorax
  - haemorrhage
  - misplacement
  - lesion to surroundings organs
  - infection („third day surgical fever”)

- Late
  - infections and secondary complications
  - venous thrombosis
  - line occlusion
  - catheter migration
  - catheter embolism
  - other late complications
Let’s me introduce myself – why I am talking about?

Personal experience since:

PN – 1974, HPN – 1983

At now: 202 patients on HPN

HPN catheter infection rate: 0.2 / year

In hospital catheter infection rate: 0.06 – 0.12 / year
Catheter related infection

– most dangerous PN complication.
## Risk of access related bacteriaemia

<table>
<thead>
<tr>
<th>Access</th>
<th>%</th>
<th>n / 1000 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cannula</td>
<td>0,2</td>
<td>0,6</td>
</tr>
<tr>
<td>Central catheter</td>
<td>3,3</td>
<td>2,3</td>
</tr>
<tr>
<td>PICC</td>
<td>1,2</td>
<td>0,4</td>
</tr>
<tr>
<td>Tunnelised catheter</td>
<td>20,9</td>
<td>1,2</td>
</tr>
<tr>
<td>HD catheter</td>
<td>6,3 – 16,2</td>
<td>1,1 - 2,8</td>
</tr>
<tr>
<td>Port</td>
<td>5,1</td>
<td>0,2</td>
</tr>
</tbody>
</table>

Causes of catheter related infections

- sloppy catheter / line handling > 50 %
- mechanical damage
- infected fluids or TNA

Entry point for about 90 % CRBI

Catheter sepsis:
The Clue is the hub.
A.Sitges-Serra et.al., 1985
Infection – most common and dangerous complication of venous access

USA
catheter related bacteriamia/fungaemia
Cost – 1 - 2 billions USD / year
Mortality - 12 – 25 %

Poland :
CRI in 90 % patients transferred with central catheter

Dept.of General Surgery and Clinical Nutrition, Warsaw
3 central catheter related bacteriaemias

UK – 30000 / year
Australia – 3500 / year


### Results of treatment of catheter related bacteraemias (FDA alert 16.03.2007)

<table>
<thead>
<tr>
<th>Strains cultured</th>
<th>Linezolid ( n = 363 ) Died – 78 (21.5%)</th>
<th>Vancomycin ---oxacillin/ dicloxacillin ( n = 363 ) Died – 58 (16 %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G + ( 437)</td>
<td>16.7 %</td>
<td>17.2 %</td>
</tr>
<tr>
<td>G – ( 26)</td>
<td>26.7 %</td>
<td>9.1 %</td>
</tr>
<tr>
<td>G + I G – ( 85)</td>
<td>34.8 %</td>
<td>17.9 %</td>
</tr>
<tr>
<td>Lacked ( 168)</td>
<td>26.3 %</td>
<td>13 %</td>
</tr>
<tr>
<td>Others (10)</td>
<td>25 %</td>
<td>16.7 %</td>
</tr>
</tbody>
</table>
Signs of catheter related infection

**Local** – easy to see
- Redness, leak from exit site, pain, suppuration
- Tunnel phlegmone

**General**
- Classic - fever, chills, shock
- Metabolic – usually not recognised
  - Acidosis, hyperglycaemia, jaundice

**Clinical** - rarely recognised
- GI tract bleeding, cough, pneumonia,
  - Renal failure, tetany
- Line dysfunction
- Central vein thrombosis

Every deterioration of patient condition could be a sign of catheter related infection.
Access related infections - terminology

I. Generalized
- With bacteriemia/ fungemia caused by infection of catheter hub, catheter internal segment, extension set, local infection or TNA contamination
- Catheter related sepsis
- Probable catheter related sepsis

II. Local infection
- Exit site
- Tunnel
- Port pocket

III. Colonization

We do not accept term “sample contamination”

This terminology is misleading
Insertion of an infected CVC into rats was followed by a significant rise in leukocytes after 4 days and the presence of S. epidermidis in lungs, livers, spleens, kidneys, and the catheter tip, as examined by bacteriological assay.

Catheter hub colonisation

5-7 days

Local external infection

2–n ? days

Infection

Bakteriaemia / fungemia

Contaminated infusion
Colonised catheter hub

External migration

Infected thrombosis
Endocarditis
Organ abscess
Endophtalmitis
Meningitis, osteomyelitis

Sepsis and organ failure

Septic shock
Catheter related sepsis is dynamic event!

Catheter related sepsis infection in HPN candidate
M.K. 82 years, short bowel HPN candidate, central port inserted 2 weeks ago
4.04.2007, 2.33 p.m – admitted to IFU Warsaw

- HR = 135
- RR 90/60 ,
- Respiration 27 / min
- 39°C,
- 3.19 p.m. pH – 7,24, BE – 19,20, 
  pO₂ – 59, pCO₂ – 19,5, 
L –19.300, PLT – 184 000, TLC –410 
Urea – 207 mg/ dl , creatinin 1,4 mg/dl, 
LDH – 836 i.u. 
P 7, 5 mg/dl

- Peripheral blood culture, central port closed
- thiamin 200 mg i.v.
- 500 ml aqua dest + 80 mmol NaHC0₃
  + 1000 ml G5 / 0, 9 % NaCl 2:1
- Rtg, USG when stabilised
  - bilateral pneumonia
- 4:20 p.m. - CRP – 366 mg / dl
- Suspected (clinically) left venous thrombosis
- 4.20 p.m. – central port removed, cultures
Patient M.K. 82 years, blood cultured 4.04., 4.20 p.m. – results 7.04 – 11.04 a.m.

- **7.04 - Blood (central + peripheral):**
  - Ps.aeruginosa – IMP/CIS - resistant
  - Piptazobactam, sulb/cephoperazon - sensitive
  - Ent.faecium – sensitive to teicoplanin
  - Candida parapsilosis – fluconazole

- **11.04 Catheter tip**
  - A/a + Acinetobacter – sensitive to IMP/CIS and sulb/cephoperazon, piptazobactam - resistant
  - Urine: Candida glabrata
  - Pharynx – Ps.aeruginosa, Acinetobacter
  - Anus - Ps.aeruginosa, Acinetobacter, Ent.faecium,

- **4.04 – empiric**
  - teicoplanin
  - fluconazole
  - IMP/CIS

- **Port removal**

- **7.04 - targeted**
  - piptazobactam
  - teicoplanin
  - fluconazole

- **11.04**
  - teicoplanin
  - sulb/cephoperazon, fluconazole
  - until 20.04.2007

- **Phlebography – 8.04 – thrombosis of left subclavian and jugular vein**

- **(USG 12.04), thrombosis of right subclavian vein**

- **13.04 – silver impregnated catheter inserted through VJD 17.05 – Broviac through VJD**

- **Fraxiparine 2 x 0.6 ml s.c**
Access related infection?

- Stop infusion
- All peripheral lines inspected / removed
- Peripheral culture from new puncture
- General treatment if required
  - Peripheral i.v. fluids when required
- Attempts to establish the cause
- Whether this is line infection?
- Other possible sources?

Dept. .2006
- 350 blood cultures
Approach to HPN patients readmitted for suspected catheter infection

1. Temporal break in usage
2. Exit site + tunnel inspection
3. Catheter removal
4. Cultures, surgical drainage

If rather not:
- Fever / chills
- Signs disappeared

General treatment
- Cultures, catheter removal?
- Empiric antibiotics?
- Other cultures: Infection search

Central catheter blood cultures:
- Culture of tip positive
  - Appropriate antibiotic
  - Positive blood culture
- Infected - removal or treatment in situ

Empiric antibiotics:
- Non-infected - search for other cause

Severe condition:
- Suspected

Appropriate antibiotic

Non-infected - search for other cause
The golden standard for diagnosis of catheter related infection (CRI) - positive cultures: peripheral blood and central line and catheter tip.

When catheter is not removed – blood taken from central line and peripheral vein. Several methods are described to confirm CRI, all required central line culture.

When there is a case of bacteriaemia of another origin, positive central culture cause misinterpretation, catheter colonisation and need for treatment/removal.

Our approach
Peripheral blood is taken on admission (HPN patient) or when episode will occur (hospital patient)
Catheter is locked.
Central blood is taken when acute phase will disappear.

In 50 % of cases suspected for CRI there is another source of infection, often with bacteriaemia.
Catheter = foreign body holding infection.

Before catheter removal microbes may invade different organs and therefore systemic antibiotic therapy is necessary.

Catheter remnants (example fibrin sheath) could be the source of generalised infection.
General rules of management

Complicated infection

- Tunnel or pocket phlegmone
  - Catheter removal
  - Antibiotic 10 – 14 days

- Thrombosis
- Endocarditis
- Osteomyelitis
- Organ abcess
  - Catheter removal
  - Antibiotic 4- 8 weeks

Noncomplicated infection

- St.aureus
- Fungi
- Mycobacterium
- Pseudomonas
  - Catheter removal
  - Antibiotic 10-14 days
  - Fungi >3 weeks

- Other organism
  - Local management?
  - Antibiotic 7-10 days

Changes Clinical Practice:

Broad-spectrum antibiotics should be administered within one hour of diagnosis of septic shock or severe sepsis. Previous guidelines recommended 'early administration of antibiotic therapy'.

Dellinger R.P., Crit.Care Med., 2008,36,296
Rules of antibiotic treatment for catheter related infections.

Empiric on admission – „first shot”

- sepsis, shock,
- severe general condition
- immunosupression
- venous thrombosis

When results of cultures available
change for most appropriate antibiotic.
„In situ sterilisation” – option for permanent catheters.


Majewska K et al.: Combined Alcohol / Antibiotic Lock Technique. 2008

Antibiotic lock for treatment CRI – common in Europe, rare in USA.
Antibiotic lock for prevention of CRI – more popular in USA than in Europe.

Training in catheter handling seems to be best solution.
Alcohol lock for prevention looks optimistic.
Local catheter related infections – different pictures

- Lymphonodulitis
- Postinsertion tunnel haematoma
- Deep infection, involving ribs related to infected dacron cuff
- Subcutaneous abscess at entry point
Tunnel / port pocket infection

Suppurative tunnel, surgical drainage

Infected tissue removed by stripping
When to insert new catheter?

- When infection will be controlled
- If the patient need CVC now –
  - insert „antimicrobial catheter” and replace within a week
- It’s better to wait 48 hours
Catheter related venous thrombosis

Common event (silent in 40-50 % PN patients)

Symptomatic - 0.2 - 16.8 %

- Mortality: early - 25 %, late - 37 %

cause of 20 % of deaths in early HPN series

Antithrombotic prophylaxis from catheter insertion?

Management
- rTPA or urokinase for sterile thrombosis followed by LMWH.

- LMWH + antibiotics for septic thrombosis, thrombus removal rarely possible
rtPA – 50 mg + 50 mg intravenous infusion + nadroparin 2 x 0,6 ml s.c.
Effects of antithrombotic prophylaxis on central vein thrombosis in HPN

1983-1996 - no prophylaxis
n – 116, thrombosis in 10 %.

1997-1998 - prophylaxis in high risk
n - 80, thrombosis in 8 %.

1999- 2007 - enoxaparin or Nadroparin from catheter insertion, changed to syncumar 1 mg /day with improved absorption
n - 300 – thrombosis in 2 %.
Take home messages

1. Understanding of patophysiology of catheter related infections, early diagnosis on clinical grounds and established sensitivity of responsible strains are key factors for patient salvage.

2. Early aggressive management decreases mortality of catheter related infection.

3. We recommend antithrombotic prophylaxis from catheter insertion, although at present there is not general agreement to use it.