Central Venous Access Devices
Educational session

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President of the Dutch Society of Infusion Technology
Organiser of 1st World Congres on Vascular Access
Background

- 34 years experience in nursing
- Background in hematology / BMT
- 6 years as CNS in the UMC painteam
- In charge of a home infusion team since 1992
- President of EBMT-NG 1989-1997
- PICC since 1997
- Consultant for infusion PIV, PICC and Ports and ambulatory pumps
- Chairperson of hospital infusion material advisory board
CVC in Hematology / SCT

- Common practice
- Guidelines / protocols
- Care aspects
- Future developments
What will you suggest: a peripheral?
Common practice?
Common practice?
Venous Access

- **PI**
  - 1st choice

- **Midline**
  - Alternative

- **Subclavian/jugular**
  - Alternative

- **PICC**
  - Tunneld catheter

- **Implanted port**

- + 3 days
- 3 days to 6 weeks
- 1 week to 4 weeks
- 1 week to 12 month
- 3 weeks to 6 month
- ≥ 6 weeks and intermittent
Peripherally Inserted Central Catheter (PICC)

- Alternative peripheral IV, subclavia and jugular
- No pneumothorax
- Suitable for all infusion agents
- Can be used for a medium till long period
- For hospital and home infusion
- Increase of quality
  - Not painful
  - Not invasive
- Single, double and triple lumen
- Cost saving
Early Use of PICCs Is Associated With Decreased CRBSI

- Transition from centrally inserted central catheters (CICCs) to open-ended PICCCs
- Decrease of CRBSI by 41%

Patel et al
Mayo clinic 2003
PICC Common Therapies

- Hyperosmolar or irritating meds or solutions (i.e. TPN, chemotherapy)
- Antibiotics
- Hydration
- Pain management
- Blood and blood products
- Limited venous access
- Multiple incompatible drugs
US+MST for PICC insertion

- Makes PICC insertion possible even in patients ‘who have no veins’
- Lower % of malpositions
- Lower % of failures
- Lower % of thrombophlebitis
- Better patient’s comfort
Ultra sound and MST
Criteria for VAD selection

- **Where are you infusing into?**
  - Evaluation for the patient’s peripheral vascular integrity-
  - Patient diagnosis/medical condition
  - Patient compliance to therapy

- **What are you infusing?**
  - Drug (s) to be administered
  - Contrast media and pressure
  - pH of drug
  - Osmolarity of admixture

- **How long are infusing?**
  - Duration of therapy
  - VAD dwell time recommendations
  - Length of therapy
  - Number/frequency of infusions
  - Alternative site infusion
Vascular access for non acute treatment in adults

Treatment plan

Properties of the infusate / drugs, blood products

Length of treatment

Quality of the veins

Type of catheter

Indications for CVP, phereses or frequent CT scanning can influence catheter choice

Indication for IV Therapy

Osmolarity

< 500 mOsm
pH > 5 or < 9

> 500 mOsm
pH < 5 or > 9

< 14 days

2 – 4 weeks

> 4 weeks

< 1 week (depending on drug)

< 3 month

> 3 month

PICC

Midline

Short peripheral

3 or more peripheral sites available

1 peripheral site available

1 or no peripheral visual or palpable veins

3 or more peripheral visual or palpable veins

Peripheral canula

PICC

Tunneled CVC or VIT

< 1 week

> 4 weeks

1 peripheral site available

3 or more peripheral visual or palpable veins

Peripheral canula

PICC

Tunneled CVC or VIT

< 1 week (depending on drug)

< 3 month

> 3 month

3 or more peripheral visual or palpable veins

Peripheral canula

PICC

Tunneled CVC or VIT
pH

- pH is the hydrogen ion concentration

pH of blood: 7.35 to 7.45 (neutral)
pH values < 7.0 are acidic
pH values > 7.0 are basic (alkaline)

- pH of < 5.0 or > 9.0 can damage the vessel walls leading to inflammation and thrombosis
Osmolarity

Osmolarity is the tension related to the number of particles per kilogram of water and how it influences water movement between the blood vessels and cells.
Osmolarity

- **Isotonic solutions**: 250-350mOsm/liter i.e. blood-285mOsm/liter, 0.9% sodium chloride, D$_5$W

- **Hypotonic solutions**: <250mOsm/liter i.e. sterile water, 0.45% sodium chloride

- **Hypertonic solutions**: >350mOsm/liter i.e. D$_{10}$W
pH of drugs

- Amikacine 3.5 - 5.5
- Ciprofloxacin 3.3 - 4.6
- Cisplatin 3.7 - 6
- Doxycycline 1.8 - 3.3
- Dopamine 2.5 - 4.5
- Gentamicine 3.0 - 5.5
- Morfine 2.5 - 6
- Vancomycin 2.5 - 4.5
- Ampicilline 8.0 - 10
- Cotrimoxazol 10
- Ganciclovir 11
- Phenytoin 12

from: “Trissel’s handbook of Injectable Drugs”
Catheter Related Blood Stream Infections

<table>
<thead>
<tr>
<th></th>
<th>No. of Catheters</th>
<th>Catheter days</th>
<th>No. of BSI</th>
<th>CRBSI per 100 devices</th>
<th>CRBSI per 1000 cath. days</th>
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<tbody>
<tr>
<td>UMC inpatient</td>
<td>418</td>
<td>13.258</td>
<td>11</td>
<td>2,63</td>
<td>0,82</td>
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<td>UMC outpatient</td>
<td>92</td>
<td>4397</td>
<td>1</td>
<td>1,09</td>
<td>0,23</td>
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<td>UMC in and outpatient</td>
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<td>12</td>
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<td>7137</td>
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<td>Maki outpatient*</td>
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<td>98.702</td>
<td>15</td>
<td>3,5</td>
<td>1,0</td>
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<tr>
<td>Maki in and outpatient*</td>
<td>3566</td>
<td>112</td>
<td>3,1</td>
<td></td>
<td>1,1</td>
</tr>
</tbody>
</table>

Maki, 2006
Van Boxtel, 2008
Results UMC Utrecht 2005-2010

Reason removal (#)
N=1202

Reason removal (%)
N=1202
Results UMC Utrecht 2005-2010

Days in situ
N=1202

- 1 - 10 days: 300
- 11 - 20 days: 304
- 21 - 30 days: 159
- > 30 days: 439
Results UMC Leiden hematology SCT

Reason removal (%)
N=388

Reason removal (#)
N=388

Nering Bogel, 2011
Results UMC Leiden hematology SCT

Days in situ  
N = 388

- 1 - 10 days: 85
- 11 - 20 days: 81
- 21 - 30 days: 160
- > 30 days: 62

Nering Bogel, 2011
Don’t go for low, go for zero

- < 5% CR-BSI is often accepted
- A bundle of interventions was implemented in the Sutter Roseville Medical Center, Roseville CA
  - In 13 month 2083 PICC
  - 98% success rate insertion by infusion team
  - 2% IR intervention

  – Zero occurrence of CR-BSI

Sophie Harnage, JAVA, 2007
Common practice

- Gloves for dressing change: sterile or not?
- Frequency of dressing change: every .... days?
- Flushing with: Saline, Heparine solution, other?
- Needleless connector:
  - Yes, which one, why?
  - No, why?
Gloves

- Use either clean or sterile gloves when changing the dressing of intravascular catheters

  CDC, 2011, category 1C

- Use the ‘no touch’ method for dressing change and flushing protocol
Guidelines / protocols

- Standards for infusion therapy, RCN 2010
- Guidelines for the prevention of intravascular Catheter Related Infections, (2011)
- Infusion Nursing Standards of Practice, 2011
Care aspects CVC

- Flushing
- Needless connector
- Dressing change
- Declotting
- Removal
- Filtering
Care aspects CVC

- **Flushing**
  - Normal saline between incompatible drugs
  - Frequency depending on:
    - Valved or open ended catheter
    - Use of correct needless connector
    - Lock solution
  - Volume at least 2 times volume of the lumen
  - Alternative locking solutions
    - Ethanol, sodium citrate, taurolidine, EDTA,
    - Prevention of biofilm
Biofilm

- Biofilm: the microbial "bunker" for intravascular catheter-related infection

Morales, Support Care Cancer, 2004
Biofilm formation

1 hr

2 hrs

6 hrs

12 hrs
Lock with: Tetrasodium EDTA, Taurolidine, etc.

- Anti-bacterial activity
- Destroy the biofilm
- Anticoagulant activity
  - Replace heparin
- No allergies
- Do not induce bacterial resistance
Care aspects CVC

- Flushing
- Needless connector
Displacement

- **negative**: Blood is entering the catheter when connecting.
- **positive**: When disconnecting, extra fluid is injected.
- **neutral**: No fluid in or out at any time.
Negative displacement
Needleless connector

- Connect to CVC hub
  - Positive displacement
  - Negative displacement
  - Non displacement / Neutral
- Disinfection before use
Care aspects CVC

- Flushing
- Needless connector
- Dressing change
Fixation and protection
## CRBSI prevention

<table>
<thead>
<tr>
<th>Organism</th>
<th>ALGIDEX</th>
<th>BIOPATCH</th>
<th>SILVERLON</th>
<th>SILVERSITE</th>
<th>SILVASORB</th>
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<tbody>
<tr>
<td>MRSE</td>
<td>No growth</td>
<td>No growth</td>
<td>Day 1</td>
<td>Day 5</td>
<td>Day 1</td>
</tr>
<tr>
<td>MRSA</td>
<td>Day 6</td>
<td>No growth</td>
<td>Day 2</td>
<td>No growth</td>
<td>Day 2</td>
</tr>
<tr>
<td>VRE</td>
<td>Day 3</td>
<td>No growth</td>
<td>Day 1</td>
<td>Day 2</td>
<td>Day 1</td>
</tr>
<tr>
<td><em>C. albicans</em></td>
<td>Day 2</td>
<td>No growth</td>
<td>Day 1</td>
<td>Day 2</td>
<td>Day 1</td>
</tr>
<tr>
<td><em>P. aeruginosa</em></td>
<td>No growth</td>
<td></td>
<td>Day 1</td>
<td>No growth</td>
<td>Day 3</td>
</tr>
<tr>
<td><em>A. baumanii</em></td>
<td>Day 4</td>
<td>No growth</td>
<td>Day 3</td>
<td>No growth</td>
<td>Day 1</td>
</tr>
<tr>
<td><em>K. pneumoniae</em></td>
<td>Day 5</td>
<td>Day 6</td>
<td>Day 4</td>
<td>Day 5</td>
<td>Day 1</td>
</tr>
</tbody>
</table>

MRSE Methicilline Resistente Staph. Epidermidis
MRSA Methicilline Resistente Staph. Aureus
VRE Vancomycine Resistente Enterococcus

Bhende, JAVA, 2007
Dressing change

- Transparent dressing should be changed every 5-7 days
- Gauze dressing should be changed every 2 days
  - If gauze is used to support a winged needle (port) with transparent dressing (5-7 days)
- Chlorhexidine impregnated dressing should be considered in patients older than 2 months
- With a well-healed tunneled CVAD consideration may be given to no dressing

Infusion Nursing Standards of Practice, 2011
Care aspects CVC

- Flushing
- Needless connector
- Dressing change
- Declotting
Full occlusion versus aspiration occlusion

Common types of catheter occlusions:

- Intraluminal thrombus
- Fibrin tail
- Mural thrombus
- Fibrin sheath
Declot protocol

urokinase

empty
Contributing factors to venous thrombosis

- Hospitalized pt’s are hypercoagulable
  - Dehydration
  - Oncology diagnoses
  - Infection
  - CVC
- A catheter “slows” flow
  - Inappropriate catheter to vein ratio can affect thrombosis
- Does this type of movement cause injury to the vessel wall?
  - Where?
    - Movement in the “shoulder” with flush
    - Tip movement in the vein
Vein, catheter ratio
Care aspects CVC

- Flushing
- Needless connector
- Dressing change
- Declotting
- Removal
Skin erosion
Remove non tunneled CVC

- End of therapy
- Doctors order
- Competent and knowledge
  - Length of the catheter
  - Culture tip if suspected
  - Prevent air embolism
    - 10 minutes pressure on insertion site
    - Semi permeable folio
- Apply warmth when resistance
  - Ask another expert
Tunneled or implanted CVC removal

- Surgical procedure
- High risk in immune-suppressed patients
Pinch off syndrome

- Difficulty with blood withdrawal
- Resistance to infusion of fluids
- Patient position changes required for infusion of fluids or blood
Care aspects CVC

- Flushing
- Needless connector
- Dressing change
- Declotting
- Removal
- Filtering
Filtering

• For non lipid and intraspinal infusions a 0.2 micron filter, particulate-retentive and air eliminating filter should be used.

• Blood and blood component filters appropriate to the therapy shall be used to reduce particulate matter, micro aggregates or leukocytes in infusion or blood components.
Future developments

- Utrasound guidance for CVC insertion
- Introduction of a tip locator
- Infusion team of experts
  - Insertion CVC
  - Care and instruction
- Less peripheral canula
- No more blind sticking (ledonne)
Hand hygiene is crucial

- Availability of hand alcohol
- Compliance of health professionals
WoCoVA 2012
World Congress Vascular Access
The Netherlands
27, 28, 29 June 2012, Amsterdam, Beurs van Berlage
www.wocova.com
websites

- Center for Disease Control and Prevention (CDC) [www.cdc.gov](http://www.cdc.gov)
- Infusion Nurses Society (INS) [www.ins1.org](http://www.ins1.org)
- Association for Vascular Access (AVA) [www.avanet.org](http://www.avanet.org)
- World Congress Vascular Access [www.wocova.com](http://www.wocova.com)
- European Venous Access Network [www.evannetwork.info](http://www.evannetwork.info)