Today’s Challenges in Vascular Access

- leading cause of hospitalization in the ESRD population (Feldman et al., 1993)
- annual cost approaching $1 billion (Feldman et al., 1996)
- aging population with diabetes as the leading cause of ESRD
- our patients need an access that works better and lasts longer
- WITH LESS PAIN AND SUFFERING!!!
Pros and Cons of Catheter Access

- **pro** - no cannulation
  - can be dialyzed immediately
  - allows for long-term fistula maturation

- **con** - high risk of bacteremia
  - endothelial damage/risk of central vessel occlusion
  - lower flow volume (through dialyzer ml/min)
  - fibrin sheath formation
  - cannot shower/swim
- **Temporary catheters**
  - 3 weeks or less
- **Acute renal failure**
- **Maturing AV access**
- **Intoxication**
- **Plasmapheresis**
- **Volume control**

- **Chronic catheters**
  - 3 weeks or more tunneled cuffed
  - Same as temporary catheters
  - **Maturation of PD access**
  - **Maturing AV access**
  - **Failure of AV access**
  - **Bridge following infection and removal of access**
Catheters

- Why place a catheter? AND if you do
- What kind of catheter - cuffed or uncuffed?
  - acute or chronic renal failure
  - bacteremic
  - you want to start dialysis when???
  - for LRD transplant soon
  - waiting to start PD or get over peritonitis
  - peripheral vascular disease
  - no more surgical access sites
  - no more surgeries thank you!
Hemodialysis access catheters
### Hemodialysis associated infections

*Am J Inf Control 30/5 2002*

- **Infection rate 100 pt/month**
  - Native (AV) fistula: 0.56
  - AV graft: 1.36
  - Cuffed catheter: 8.42
  - Non cuffed catheter: 11.98
  - Overall: 3.2
Indications for vascular access removal

- Proven infection of graft or shunt
- Repeated positive blood cultures
- Exit site or tunnel infection unresponsive to treatment
Indications for PD catheter removal (absolute)

- Abdominal perforation*
- Fungal peritonitis *
- Tb peritonitis*
- Exit-site infection
  - Pseudomonas
  - S. aureus with tunnel infection

* may attempt to treat initially
Indications for PD catheter removal (absolute)

Abdominal perforation*
Fungal peritonitis *
Tb peritonitis*
Exit site infection
Pseudomonas
S. aureus with tunnel infection

* may attempt to treat initially
Indications for PD catheter removal (elective)

Repeated peritonitis with same organism

Frequent peritonitis relapse

Peritonitis unresponsive to treatment

Disfunctional catheter

(copious proud flesh, extruded cuff, obstruction, etc.)
PD catheter replacement

**Same day**

- All elective replacements
- Peritonitis (treated, cell count < 100)
- Exit site infection (under antibiotic coverage)

2-3 weeks wait

- Unresponsive peritonitis

4-6 weeks wait

- Tb or fungal peritonitis
Antibiotic Lock Therapy

- **Which antibiotic?**
  - vancomycin, cefazolin, ceftazidime, & gentamycin

- **How much?**
  - 10mg/ml 1,2,3 & 5mg/ml for gentamycin

- **With heparin 5000 u/s per ml**

- all 4 stable in vitro - some adsorbency in CVCs

- **Need clinical study in vivo**
  
  (Vercaigne et al, Pharmacotherapy, 7/2000)
Fig. 1. Potential sources for contamination of intravascular devices.
External Catheter Care

- Is there a universal bactericide for catheter port soaking and exit site cleaning?
- Exit site - to dress or not to dress? And with what? And how often?
- Can the patient shower or swim?
- Securing the catheter for safety
- Catheter repairing
Use the Proper Precautions!

- Face masks for you and the patient
- Gloves
- Aprons
- Aseptic technique
Catheters in the Future

- Antibiotic locking therapy standard
- Antimicrobial locking solutions such as taurolidine prophylactically (Neutrolin by Biolink)
- Subcutaneous catheter ports
  - Dialock by Biolink
  - Lifesite by Vasca
- FDA approved and reimbursed lytic therapy
- cohesive collaborative care to increase catheter safety and effectiveness
Infection in HD patient with tunneled central venous catheter

- Tunnel infection
  - Remove catheter
  - Antibiotics for 2-3 weeks
  - Replace catheter at new venotomy site
  - Observe
    - Yes: Infection resolved
    - No: IV antibiotics
      - Observe
        - Yes: Infection resolved
        - No: Catheter management
          - Option 1: Remove catheter; replace at new venotomy site
          - Option 2: Remove catheter; exchange at same venotomy site but with a new tunnel

- Exit site infection
  - Local antiseptic measures to exit site
  - Yes: Infection resolved
  - No: IV antibiotics
    - Observe
      - Yes: Infection resolved
      - No: Catheter management
        - Option 1: Remove catheter; replace at new venotomy site
        - Option 2: Remove catheter; exchange at same venotomy site but with a new tunnel

- Bacteremic infection
  - IV antibiotics for 3-4 weeks
  - Severe clinical symptoms present
    - Yes: Catheter management
      - Immediate catheter removal
      - Delayed catheter replacement at new venotomy site
    - No: Evidence of exit site infection
      - Yes: Catheter management
        - Option 1: Remove catheter; replace at new venotomy site
        - Option 2: Remove catheter; exchange at same venotomy site but with a new tunnel
      - No: Catheter management
        - Option 1: Remove catheter; replace at new venotomy site
        - Option 2: Remove catheter; exchange at same venotomy site but with a new tunnel
Infection in HD patient with arteriovenous graft

- Bacteremia with local signs of AV graft infection
  - Yes
  - Severe clinical symptoms
  - IV antibiotics for 3-4 weeks
  - Total or partial surgical excision of AV access
  - Observe
  - Infection resolved
    - Yes
    - Observe
    - No
    - Local conservative surgery (excision of involved segment of AV graft)
    - Continue specific antibiotics
    - Observe
    - Infection resolved
      - Yes
      - Observe
      - No

- Local signs of AV graft infection without bacteremia
  - IV antibiotics for 3-4 weeks
  - Local conservative measures to involved AV access site
  - Observe
  - Infection resolved
    - Yes
    - Observe
    - No

- Bacteremia without signs of AV graft infection
  - IV antibiotics for 3-4 weeks
  - Infection resolved
    - Yes
    - Observe
    - No
    - Cause of bacteremia found
      - Yes
      - Treat accordingly
      - No
    - Perform indium scan
    - Continue antibiotics
    - Indium scan shows uptake in AV graft
      - Yes
      - Surgical excision of AV graft
      - Specific antibiotics for 3 weeks
      - Search for other source
      - No
      - Continue antibiotics
      - No

- Infection unrelated to AV access
  - Treat accordingly
The patient presenting with fever

No

Evidence of localized infection?

Yes

Treat accordingly

No

Is infection life-threatening?

Yes

Treat with vancomycin + gentamycin or vancomycin + third-generation cephalosporin

No

Presence of central venous dialysis catheter?

Yes

Treat with vancomycin + gentamycin or vancomycin + third-generation cephalosporin

No

High incidence of MRSA or Staphylococcus epidermidis sepsis?

Yes

Treat with vancomycin + gentamycin or vancomycin + third-generation cephalosporin

No

Consider cefazolin ± gentamycin
<table>
<thead>
<tr>
<th>Source [reference]</th>
<th>Country</th>
<th>Year</th>
<th>N</th>
<th>Incidence of bacteremia per 100 patient-years</th>
<th>Bacteremia due to vascular access</th>
<th>% bacteremia due to gram-positive cocci</th>
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</thead>
<tbody>
<tr>
<td>Dobkin et al. [13]</td>
<td>USA</td>
<td>1978</td>
<td>N/A</td>
<td>15</td>
<td>73%</td>
<td>70% a</td>
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<tr>
<td>Kessler et al. [8]</td>
<td>France</td>
<td>1993</td>
<td>1455</td>
<td>8.4</td>
<td>51%</td>
<td>69.80%</td>
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<tr>
<td>USRDS [1]</td>
<td>USA</td>
<td>1996</td>
<td>USRDS</td>
<td>7.6</td>
<td>48%</td>
<td>N/A</td>
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<td>Marr et al. [9]</td>
<td>USA</td>
<td>1998</td>
<td>445</td>
<td>14.4</td>
<td>89%</td>
<td>100%</td>
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<td>Kaplowitz et al. [18]</td>
<td>USA</td>
<td>1988</td>
<td>71</td>
<td>8.4</td>
<td>27%</td>
<td>50% c</td>
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<tr>
<td>Hoen et al. [20]</td>
<td>France</td>
<td>1998</td>
<td>988</td>
<td>11.2</td>
<td>N/A</td>
<td>68%</td>
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</tbody>
</table>

N denotes number of hemodialysis patients during the study period. N/A denotes data not available.

- aRate applies if bacteremia is vascular access-related
- bA study on *staphylococcal aureus* bacteremia
- cPercent of combined bacteremic and nonbacteremic infections related to vascular access
<table>
<thead>
<tr>
<th>Source [reference]</th>
<th>Country</th>
<th>Year</th>
<th>N</th>
<th>Incidence of CRB per 1000 catheter-days</th>
<th>% CRB due to gram-positive cocci</th>
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</thead>
<tbody>
<tr>
<td>Moss et al. [28]</td>
<td>USA</td>
<td>1990</td>
<td>131</td>
<td>0.7</td>
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<td>Marr et al. [29]</td>
<td>USA</td>
<td>1997</td>
<td>102</td>
<td>3.9</td>
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<td>Kairaitis and Gottlieb [21]</td>
<td>Australia</td>
<td>1999</td>
<td>105</td>
<td>6.5</td>
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<td>Beathard [30]</td>
<td>USA</td>
<td>1999</td>
<td>387</td>
<td>3.4</td>
<td>84.5% b</td>
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<tr>
<td>Saad [31]</td>
<td>USA</td>
<td>1999</td>
<td>101</td>
<td>5.5</td>
<td>67.4% c</td>
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<td>Cuevas et al (abstract) a</td>
<td>Spain</td>
<td>1999</td>
<td>189</td>
<td>1.54</td>
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<td>Spain</td>
<td>1999</td>
<td>45</td>
<td>1</td>
<td>84%</td>
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</tbody>
</table>

N denotes number of patients with hemodialysis catheters; N/A denotes data not available.

a A study on temporary dialysis catheters

b Includes 9.8% of cultures due to mixed gram-positive and gram-negative infections

c Includes 12.8% cultures with mixed gram-positive and gram-negative infections

Nassar, George M. & Ayus, Juan Carlos
Infectious complications of the hemodialysis access.
**Table 3.** Risk factors for arteriovenous graft infection

- Diabetes mellitus
- Immuno-incompetency
- Renal transplantation
- Indwelling central venous catheter
- History of bacteremia
- Previous major infection in any organ system
- Previous arteriovenous graft-related infection
- Previous arteriovenous graft-related surgery
- Fever of unknown origin

Nassar, George M. & Ayus, Juan Carlos
Available from: http://dx.doi.org/10.1038/ki.2001.00725