Bioactive Hemodialysis Catheter Coatings: Latest Data

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Causes of Catheter Failure
- Infection
- Thrombosis
- Fibrin Sheath

Normal Microbial Skin Counts
- Antecubital space
  10 colony-forming units/cm²
- Subclavian and Internal Jugular veins
  1000-10,000 colony-forming units/cm²

It’s All About the Biofilm

Antibiotic Prophylaxis: Is it Needed for Dialysis Access Procedures?

- 3162 procedures
- Prophylaxis probably not warranted except
  - PD catheter procedures
  - Accidentally extruded tunneled catheter placement
SDS PAGE preparation of the outer membrane proteins of *Pseudomonas aeruginosa* cells in planktonic and biofilm states.

**Medical Devices Associated with Biofilm Infections**

<table>
<thead>
<tr>
<th>Catheters</th>
<th>Implants</th>
<th>Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central venous catheters</td>
<td>Pacemaker and leads</td>
<td>Vascular stents</td>
</tr>
<tr>
<td>Hemodialysis catheters</td>
<td>Arteriovenous shunts</td>
<td>Mechanical heart valve</td>
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<td>Arterial catheters</td>
<td>Bypass grafts</td>
<td>Vascular stents</td>
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<td>Arterial catheters</td>
<td>Prosthetic valves</td>
<td>Joint prostheses</td>
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<tr>
<td>Intravenous catheters</td>
<td>Vascular access devices</td>
<td>Vascular grafts</td>
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<td>Vascular access devices</td>
<td>Orthopedic implants</td>
<td>Vascular access devices</td>
</tr>
</tbody>
</table>

**Chronic Biofilm-Related Diseases**

- Cystic Fibrosis
- Endocarditis
- Otitis media
- Prostatitis
- Osteomyelitis
- Chronic wounds
- Myeloidosis
- Tonsillitis
- Periodontitis
- Dental Caries
- Necrotizing fasciitis
- Biliary tract infection
- Legionnaire’s disease
**Catheter Coating Types**

- **Antibiotic**
  - Minocycline/rifampin
  - 5-Fluorouracil
- **Antiseptic**
  - Chlorhexidine + heparin
  - Silver sulfadiazine
  - Silver or other metals
- **Antithrombotic**
  - Heparin

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**Critical Care Literature**

- Systematic review 37 randomized, controlled trials involving 11,568 patients
- Coated vs. non-coated catheters
- Coated vs. coated catheters
- Do coated CVC reduce:
  1. CRB?
  2. Bacterial colonization?

Gilbert and Harden, *Curr Opin Infect Dis*, 2008

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**Study Conclusions**

- For central venous catheters in ICU patients, best options for reducing infection—
  - Heparin coated catheters
  - Antibiotic coated catheters

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**In addition...**

- Cost effective
  - if the incidence of bloodstream infections > 3.3/1000 catheter-days
- For every 300 catheters used
  - Approx $60,000 would be saved
  - 7 CRB and 1 death prevented
Coated hemodialysis catheters?

Coated, Non-tunneled Hemodialysis Catheters

ARROWGard Blue®
- 12 and 14 French
- 13, 16, 20 and 25 cm
- Chlorhexidine-SS
- Exterior of catheter only

Heparin Coated
- 12 French, 16 cm
- Heparin bonded
- Internal & external surfaces

No clinical trial data using these catheter coatings in dialysis patients.

Coated, tunneled hemodialysis catheters

Surface-Treated Catheters

Palindrome® catheters
(Kendall / Tyco Healthcare)

14.5 Fr Hemodialysis Catheter

Duraspan®
(4 Vascular)

The coating is a surfactant polymer that mimics the glycocalyx cells in the body, attempting to make the catheter look like natural tissue to slow the clotting cascade.

Data Using Surface-Treated Catheters in the Hemodialysis Population

Dwyer: Surface-Treated Catheters – A review. Seminars in Dialysis, 2008
HemoSplit® vs. Palindrome Ruby®

- *case-controlled study*
- *new placements/exchanges*

- 100 catheters HemoSplit (control group)
- 100 catheters Palindrome Ruby (treatment group)

- 68% Internal Jugular Vein
- 31% Femoral Vein

Patients followed for 9,765 catheter days
Patients followed for 11,173 catheter days

Kakkos et al, 2008

Decathlon® vs. Uncoated MedComp

- *retrospective study*
- *Internal jugular only*

- 175 Catheters in 175 Patients (New Insertions)
- 86 catheters MedComp (non-coated)
- 89 catheters Decathlon (Heparin-coated)

Retrospective Data collected:
- Time to catheter removal, failure, exchange
- Infection rates
- tPA instillations
- Blood flow rates

Jain et al, 2009

<table>
<thead>
<tr>
<th>Catheter Outcomes</th>
<th>Heparin Coated (Decathlon®)</th>
<th>Non-coated (MedComp)</th>
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</thead>
<tbody>
<tr>
<td>Number of Patients</td>
<td>86</td>
<td>86</td>
</tr>
<tr>
<td>Catheter Malfunction</td>
<td>17 (19%)</td>
<td>13 (19%)</td>
</tr>
<tr>
<td>Catheter-Related Bacteremia</td>
<td>26 (31%)</td>
<td>22 (26%)</td>
</tr>
<tr>
<td>Elective Removal</td>
<td>31 (35%)</td>
<td>17 (20%)</td>
</tr>
<tr>
<td>Remained Patent</td>
<td>11 (12%)</td>
<td>4 (5%)</td>
</tr>
<tr>
<td>tPA Instillations (per 1000 catheter days)</td>
<td>1.8</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Kakkos et al, 2008

HemoSplit® vs. Palindrome Ruby®

- 31% HemoSplit catheters inserted into femoral vein
- 9% Palindrome catheters inserted into femoral vein

Jain et al, 2009

Decathlon® vs. Uncoated MedComp

- 31% HemoSplit catheters inserted into femoral vein
- 9% Palindrome catheters inserted into femoral vein

Surface-Treated Catheters in Development

- Bard: Carmeda® bioactive surface (heparin bonded)
- MedComp: Ciprofloxacin bonding
- Angiotech: 5- Fluorouracil coating
Coated Catheters: Conclusions

- Catheter coatings are a new technology
  - Antimicrobial, antiseptic and antithrombotic
- Data supports the use of surface treated catheters in the ICU
- They may decrease complication rates and improve catheter survival in dialysis patients
- Randomized, controlled trials of all coating types are needed to determine their full effectiveness