INFECTIOUS COMPLICATIONS OF PERITONEAL DIALYSIS

J. Vande Walle,
With special thanks to
S. Bakkaloluğlu, C Aufricht, A. Edefonti,
R. Shroff, W. Van Biesen
• PD Peritonitis prevention - diagnosis - management
• Exit-site infections
• tunnel infections
Peritonitis rate is decreasing!

NAPRTCS 2011 - Significant improvement is seen since 2002 with the annualized rate of infection decreasing from 0.79 in 1992-1996 to 0.44 in recent years.

Higher than an annualized rate of 0.5 is not acceptable.
Reasons for Hospitalizations

- Anemia
- Non-compliance
- Hernia surgery
- Catheter surgery
- Other infections
- Dehydration
- Hypervolemia
- Peritonitis

Schafer F, Orlando 2008

International Pediatric Peritoneal Dialysis Network
Reasons for dialysis termination

* Other than transplantation

NAPRTCS 2007

Excessive infections accounted for more than 30% of PD terminations – NAPRTCS 2011 Report

n=1356, Tx: 370; death: 37, disc'd for other reasons: 146
Causes of death in PD and HD patients (%)

- **Infections**: 22.9%
- **Cancer**: 5.7%
- **Recurrence**: 1.4%
- **Unknown**: 12.1%
- **Cardiopulmonary**: 22.1%
- **Dialysis-related complications**: 4.3%
- **Hemorrhage**: 5%
- **Other**: 26.4%

USRDS 2013 - infection is the leading cause for hospitalization and the second-most common cause of death in children receiving PD
Peritonitis

- Hospitalisation
  - Socio-economic cost
- Catheter loss
  - “ruining” life-time access-reservoir
  - Integrated care
- Loss “of dialysis capacity
  - Technique survival
- Burden (child /family)
- Risk of death
Need for guidelines

BY FAILING TO PREPARE, YOU ARE PREPARING TO FAIL.

Benjamin Franklin
Founding Father of the United States
1706 - 1790
QUOTEHD.COM
Do we need guidelines?
Do we need guidelines?
Do we need guidelines?
The spy who loved me
Licence to kill
ISPD GUIDELINES/RECOMMENDATIONS

CONSSENSUS GUIDELINES FOR THE PREVENTION AND TREATMENT OF
CATHETER-RELATED INFECTIONS AND PERITONITIS IN PEDIATRIC
PATIENTS RECEIVING PERITONEAL DIALYSIS: 2012 UPDATE

Bradley A. Warady,1 Sevcan Bakkaloglu,2 Jason Newland,1 Michelle Cantwell,3 Enrico Verrina,4 Alicia Neu,5 Vimal Chadha,2 Hui-Kim Yap,5 and Franz Schaefer7

Division of Pediatric Nephrology,1 Children’s Mercy Hospital and Clinics, Kansas City, Missouri, USA; Gazi University,2 Ankara, Turkey; Great Ormond Street Hospital,3 London, England; G. Gaslini Children’s Hospital,4 Genoa, Italy; Johns Hopkins University School of Medicine,5 Baltimore, Maryland, USA; National University of Singapore,6 Singapore; and University Children’s Hospital,7 Heidelberg, Germany.
GUIDELINE 1 – TRAINING

1.1 We suggest that PD training be performed by an experienced PD nurse with pediatric training, using a formalized teaching program that has clear objectives and criteria, and that incorporates adult-learning principles (2C).

1.2 We suggest that retraining be provided to all caregivers periodically. We also suggest that re-evaluation of the PD technique be conducted after development of a peritonitis episode (2C).

ISPD GUIDELINES/RECOMMENDATIONS

CONSENSUS GUIDELINES FOR THE PREVENTION AND TREATMENT OF CATHETER-RELATED INFECTIONS AND PERITONITIS IN PEDIATRIC PATIENTS RECEIVING PERITONEAL DIALYSIS: 2012 UPDATE

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International Pediatric Peritonitis Registry

Login to Patient and/or Peritonitis Data Input

Help

Emetic therapy
Important dosing recommendations
Quick help
Granulocyte/macrophage colony stimulating factor
Criteria for diagnosis
Granulocyte colony stimulating factors

Data analysis
Links

This page was visited 626 times. Currently, 239 peritonitis episodes (52% of 460 episodes) of 199 patients have been included in the registry.

Visit our address: 139 300-183
PD Catheter Related Interventions:

- Implantation/Care Best Practices and Preventive Strategies (Mostly Opinion based)
  
  - Pre-op prophylaxis with iv. antibiotics
  - Double cuffs, downward or lateral directed exit-site
  - Locate superficial cuff 2 cm from the exit site
  - No incision, no sutures at the exit site
  - Catheter anchoring and immobilization
  - Dressing changes should be avoided in the first week
  - If possible, do not use the catheter at least for two weeks
• 54 patients
• Mean age: 6.9 ± 6.7 yrs
• 1099 pt-months
• 36 patients received dx 1997-2000
• 18 patients: 2001-2004
• 14 patients: Both periods

• Prophylactic measures
  – Double cuff, swan neck Tenckhoff
  – Cefazolin at the cath insertion
  – Fibrin glue for immediate use
  – Weekly ES care until healed
  – Intranasal mupirocin to the carriers
  – Open surgical implantation mostly by a single surgeon
  – No sutures at the exit-site
  – Immediate ES care with poloxamer
  – Chronic ES care with chlorhexidine/ daily
  – Fungal prophylaxis

Peritonitis: Source of Infection - IPPR

Unknown: 70%

- Touch contamination: 11.4%
- Exit site/tunnel infection: 6.7%
- Catheter perforation/leakage: 4.2%
- Accidental disconnection: 3.0%
- Other abdominal surgery: 2.6%
- Catheter insertion: 2.1%
- Procedure related to Gastric Tube / PEG: 1.9%
- Noncompliance, poor social situation: 1.6%
- Urinary Tract Surgery: 0.9%
Spectrum of Causative Organisms - IPPR

International Pediatric Peritonitis Registry; n=501

- Gram negative
- Staph aureus
- Coag.neg. staph
- Streptococci
- Enterococci
- Fungal

Culture negative

(% of positive cultures)
<table>
<thead>
<tr>
<th>Clinical presentation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloudy Fluid</td>
<td>98-100%</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>67-97%</td>
</tr>
<tr>
<td>Abdominal tenderness</td>
<td>62-79%</td>
</tr>
<tr>
<td>Fever</td>
<td>34-36%</td>
</tr>
<tr>
<td>Nausea</td>
<td>30-35%</td>
</tr>
<tr>
<td>Vomiting</td>
<td>25-30%</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>7-15%</td>
</tr>
</tbody>
</table>
Diagnosis

- cell count,
- differential count
- culture to confirm the diagnosis of peritonitis

- WBC > 100/mm³, and at least 50% of the WBCs are PMNL

- centrifugation of effluent
- culture of sediment
- blood-culture bottles as the standard culture technique
Other causes of cloudy dialysate

- Non-infectious inflammation
  - Sterile peritonitis
    - Peptidoglycans
    - Excess GDP
    - Chemical peritonitis e.g. some brands of vancomycin (additives)
    - Eosinophilic peritonitis on air exposure
    - Pancreatitis
  - Non-inflammatory
    - Chylous leakage: lymphatic obstruction
    - Triglycerides
    - Menstruation
Empiric antibiotic therapy

Start intraperitoneal antibiotics as soon as possible
Allow to dwell for 3-6 hours

Monotherapy with cefepime

If cefepime is not available

Gram-positive coverage:
Either first-generation cephalosporin or glycopeptide

Gram-negative coverage:
Either ceftazidime or aminoglycoside

If the center’s MRSA rate exceeds 10% or patient has history of MRSA colonization, glycopeptide should be added to cefepime or should replace the first generation cephalosporin for gram-positive coverage. Glycopeptide usage can also be considered if patient has a history of severe allergy to penicillins and cephalosporins.
Empiric antibiotic therapy

Start intraperitoneal antibiotics as soon as possible
Allow to dwell for 3-6 hours

- Ensure gram-positive and gram-negative coverage
  - Base selection on historical patient and center susceptibility patterns as available
  - Gram-positive coverage: Either first-generation cephalosporin or glycopeptide¹
  - Gram-negative coverage: Either ceftazidime or aminoglycoside

If the center’s MRSA rate exceeds 10% or patient has history of MRSA colonization, glycopeptide should be added to cefepime or should replace the first generation cephalosporin for gram-positive coverage. Glycopeptide usage can also be considered if patient has a history of severe allergy to penicillins and cephalosporins.
Cefepime

- 4th generation cephalosporine

- Coverage of methicillin-sensitive Gram positive and Gram negative spectrum

- Superior coverage of Enterobacteriaceae, comparable Pseudomonas coverage as ceftazidime (80%); 50% ESBL sensitivity

- Mainly renal elimination, half-life 12 hours

- Excellent systemic absorption upon ip administration, good penetration from circulation into peritoneal cavity

- Dose: 15 mg/kg i.p. once daily during > 6-hour dwell
<table>
<thead>
<tr>
<th>Drug Class</th>
<th>Continuous therapy</th>
<th>Intermittent therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Loading dose</td>
<td>Maintenance dose</td>
</tr>
<tr>
<td>Aminoglycosides&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gentamicin</td>
<td>8 mg/L</td>
<td>4 mg/L</td>
</tr>
<tr>
<td>Netilmicin</td>
<td>8 mg/L</td>
<td>4 mg/L</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>8 mg/L</td>
<td>4 mg/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>anuric: 0.6 mg/kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>non-anuric: 0.75 mg/kg.</td>
</tr>
<tr>
<td>Cephalosporins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefazolin</td>
<td>500 mg/L</td>
<td>125 mg/L</td>
</tr>
<tr>
<td>Cefepime</td>
<td>500 mg/L</td>
<td>125 mg/L</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>500 mg/L</td>
<td>250 mg/L</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>500 mg/L</td>
<td>125 mg/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 mg/kg</td>
</tr>
<tr>
<td>Glycopeptides&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td>1000 mg/L</td>
<td>25 mg/L</td>
</tr>
<tr>
<td>Teicoplanin&lt;sup&gt;c&lt;/sup&gt;</td>
<td>400 mg/L</td>
<td>20 mg/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 mg/kg; repeat dosing 15 mg/kg every 3-5 days</td>
</tr>
<tr>
<td>Penicillins&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>125 mg/L</td>
<td></td>
</tr>
<tr>
<td>Quinolones</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>50 mg/L</td>
<td>25 mg/L</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aztreonam</td>
<td>1000 mg/L</td>
<td>250 mg/L</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>300 mg/L</td>
<td>150 mg/L</td>
</tr>
<tr>
<td>Imipenem/Cilastin</td>
<td>250 mg/L</td>
<td>50 mg/L</td>
</tr>
<tr>
<td>Oral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linezolid</td>
<td>&lt; 5 yrs: 30 mg/kg/day divided TID; 5-11 yrs: 20 mg/kg/day divided BID; &gt; 12 yrs 600 mg/dose BID</td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td>30 mg/kg/day divided TID</td>
<td></td>
</tr>
<tr>
<td>Rifampin</td>
<td>10-20 mg/kg/day divided BID</td>
<td></td>
</tr>
<tr>
<td>Antifungals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluconazole</td>
<td>6 – 12 mg/kg IP, IV or PO every 24-48 hrs (max dose 400 mg)&lt;sup&gt;#&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Caspofungin</td>
<td>IV only: initial dose 70 mg/m² on day 1 (max dose 70 mg); Subsequent dosing 50 mg/m² daily (max dose 50 mg)</td>
<td></td>
</tr>
</tbody>
</table>
Gram-positive bacteria on culture

Stop gram-negative coverage

Enterococcus sp.
- Discontinue initial antibiotics
- Start ampicillin
- Consider adding aminoglycoside for Enterococcus
- If resistant to ampicillin start vancomycin
- For VRE consider daptomycin or linezolid

MRSA
- Discontinue cefazolin, or cefepime
- Continue or substitute vancomycin or teicoplanin
- Consider clindamycin if allergic to glycopeptide
- Consider adding rifampin in case of poor response

MSSA
- Discontinue vancomycin
- Treat with cefazolin or cefepime

Other gram-positive bacteria
- Treat based on susceptibilities

MRSA-methicillin resistant S. aureus; methicillin sensitive S. aureus; VRE-vancomycin resistant enterococci.
<table>
<thead>
<tr>
<th>Gram-positive bacteria + recommended AB and length of therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommended Antibiotic(s)</strong></td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>Methicillin-resistant S. aureus</td>
</tr>
<tr>
<td>Methicillin-susceptible S. aureus</td>
</tr>
<tr>
<td>Coagulase negative staphylococci</td>
</tr>
<tr>
<td>Enterococcus sp.</td>
</tr>
<tr>
<td>Vancomycin resistant enterococcus</td>
</tr>
<tr>
<td>Streptococcus species</td>
</tr>
</tbody>
</table>
Gram-negative bacteria on culture

Stop gram-positive coverage

*Pseudomonas* sp.
- Continue cefepime or ceftazidime
- Add second agent with a different mechanism of action

*E. coli, Proteus* sp.
- Continue cefepime, ceftazidime

*Klebsiella* sp.
- *E. coli, Proteus sp., or Klebsiella sp.* Resistant to 3rd generation cephalosporins
  - Discontinue cefepime or ceftazidime
  - Treat with carbapenem or fluoroquinolone

Other single gram-negative bacteria
- Treat based on susceptibility results
Gram-negative bacteria and the recommended antibiotics and length of therapy.

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Recommended Antibiotic(s)*</th>
<th>Length of Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli, Klebsiella sp.</td>
<td>Cefazolin, cefepime, ceftazidime, ceftriaxone/ cefotaxime</td>
<td>2 weeks</td>
</tr>
<tr>
<td>E. coli, Klebsiella sp. resistant to 3rd generation cephalosporins</td>
<td>Carbapenem** or fluoroquinolone</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Enterobacter sp., Citrobacter sp., Serratia sp., Proteus sp.</td>
<td>Cefepime, ceftazidime or carbapenem**</td>
<td>2-3 weeks</td>
</tr>
<tr>
<td>Acinetobacter sp.</td>
<td>Cefepime, ceftazidime or carbapenem</td>
<td>2-3 weeks</td>
</tr>
<tr>
<td>Pseudomonas species</td>
<td>Cefepime, ceftazidime, piperacillin or ticarcillin, plus aminoglycoside or fluoroquinolone</td>
<td>3 weeks – 4 weeks</td>
</tr>
<tr>
<td>Stenotrophomonas maltophilia</td>
<td>Trimethoprim/sulfamethoxazole, Ticarcillin/clavulanic acid, tigecycline, colistin</td>
<td>3 weeks – 4 weeks</td>
</tr>
</tbody>
</table>
Culture

- If the initial cultures remain sterile at 72 hours and signs and symptoms of peritonitis are improved
  - empiric antibiotic therapy consisting of cefepime, cefazolin, a glycopeptide and/or ceftazidime be continued for 2 weeks
  - the administration of an aminoglycoside be discontinued
- If no improvement,
  - repeat culture studies
  - After 5 days, remove the catheter
Fungal peritonitis

- <2% of all peritonitis episodes in children
- Risk factors
  - Prior antibiotic use
  - Gastrostomy?
  - Antifungal prophylaxis during antibiotic usage in programs with high rates of fungal peritonitis
- If fungi are identified by Gram stain or culture of peritoneal effluent, therapy should consist of treatment with an antifungal agent and early catheter removal
- Following catheter removal, antimycotic therapy be administered for 2 weeks or longer after catheter removal and complete resolution of the clinical symptoms of infection
• Fluconasole for Candida species
• Caspofungin for non responding non-albicans Candida
• Voriconasole for Aspergillus

• Treatment duration following catheter removal should be 2 weeks or longer following complete resolution of the clinical symptoms of infection

  – Amphotericin B
    • Poor peritoneal penetration
    • Intraperitoneal irritation and abdominal pain
## Indications for catheter removal and replacement

<table>
<thead>
<tr>
<th>Catheter removal</th>
<th>Reinsertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refractory bacterial peritonitis</td>
<td>After 2-3 weeks</td>
</tr>
<tr>
<td>Fungal peritonitis</td>
<td>After &gt;2 weeks</td>
</tr>
<tr>
<td>ESI/TI in conjunction with peritonitis with the same organism (mainly, S. aureus and P. aeruginosa; except CNS)</td>
<td>After 2-3 weeks</td>
</tr>
<tr>
<td>Simultaneous removal and replacement of the catheter</td>
<td>Relapsing or refractory ESI/TI (including P. aeruginosa)</td>
</tr>
<tr>
<td>Relapsing peritonitis</td>
<td></td>
</tr>
<tr>
<td>Relative indications for removal</td>
<td>Repeat peritonitis</td>
</tr>
<tr>
<td>Peritonitis with multiple enteric organisms due to an intra-abdominal pathology/ abscess; so-called surgical peritonitis</td>
<td></td>
</tr>
</tbody>
</table>
Indications for removal of the catheter

- Fungal peritonitis
- Severe intrabdominal sepsis or shock
- Exit site infection due to the same organism
- Relapse with same organism after 4 weeks
- WCC>100 after 3-4 days if infection severe, 7 days if mild
- Symptomatic after 3-4 days
After catheter removal

• Continue antibiotics for 5-7 days
• Do not reinsert catheter until
  – Peritonitis gone
  – Staph aureus eliminated
  – Catheter tunnel clear of infection
ROLE OF HOST DEFENSE IN INFECTIOUS COMPLICATIONS

A. Infectious agent

Route of infection

Host

Microorganism: virulence factors

Infection

Host: defence mechanisms

Health
Peritoneal defense mechanisms

• Cellular defense:
  – Peritoneal PMN in PD-patients are in a “chronically elicited” state, with a decreased response upon stimulation, possibly due to low pH, glucose, GDP’s, osmolarity and the presence of uremic toxins in the dialysate

  Topley et al, Kidney Int, 34, 404-411, 1988
  Jörres et al, Perit Dial Int, 13, suppl 2, S291-S294
GDP : Effects on Host Defense

Phagocytosis and TNF-α release in monocytes are dependent on intracellular pH


**TNF-α (ng/ml/10^6 cells)**

<table>
<thead>
<tr>
<th>Intracellular pH</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>con</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
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<tr>
<td>6.0</td>
<td>*</td>
<td>*</td>
<td>2</td>
<td>3</td>
<td>4</td>
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</tr>
<tr>
<td>6.3</td>
<td>*</td>
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<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6.5</td>
<td>*</td>
<td>*</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>7.1</td>
<td>*</td>
<td>*</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**% Phagocytosis**

<table>
<thead>
<tr>
<th>Intracellular pH</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>con</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
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<tr>
<td>6.0</td>
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<td></td>
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<tr>
<td>6.3</td>
<td></td>
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<tr>
<td>6.5</td>
<td></td>
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<tr>
<td>7.1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Effect of pH on respiratory burst activation of PMN

Chemiluminescence response

Liberek, Topley, Jörres et al, Nephron 1993; 65: 260-265
Peritonitis: BalANZ

Cox Balanced HR 0.50 (95% CI 0.30-0.84)
(Adj for diabetes, baseline GFR, PD modality)
Exit-site / Tunnel infections
# Exit-site scoring system

<table>
<thead>
<tr>
<th></th>
<th>0 Points</th>
<th>1 Point</th>
<th>2 Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Swelling</strong></td>
<td>No</td>
<td>Exit only (&lt; 0.5cm)</td>
<td>Including part of or entire tunnel</td>
</tr>
<tr>
<td><strong>Crust</strong></td>
<td>No</td>
<td>&lt; 0.5cm</td>
<td>&gt; 0.5cm</td>
</tr>
<tr>
<td><strong>Redness</strong></td>
<td>No</td>
<td>&lt; 0.5cm</td>
<td>&gt; 0.5cm</td>
</tr>
<tr>
<td><strong>Pain on pressure</strong></td>
<td>No</td>
<td>Slight</td>
<td>Severe</td>
</tr>
<tr>
<td><strong>Secretion</strong></td>
<td>No</td>
<td>Serous</td>
<td>Purulent</td>
</tr>
</tbody>
</table>

Schaefer et al., J Am Soc Nephrol 1999
Causative Organisms at Exit Site

% of 58 episodes

- S. aureus non-MRSA / MRSA
- S. epi. / other coag. neg. Staph.
- Pseudomonas
- Streptococci
- E.coli
- Other grampositive
- Other gramnegative
- Enterococci
Treatment of Exit-site / Tunnel Infections

• Exit-site infections:
  – Score 4-5
  – Oral antibiotic therapy when culture results and susceptibilities available
  – Gram positive usually penicillinase-resistant penicillin or cefalexin
  – Gram negative IP ceftazidime, combination therapy for Pseudomonas
  – a minimum of 2 weeks (3 weeks for S. aureus and P. aeruginosa, max 4 weeks)
  – at least 7 days following complete resolution of the infection

Tunnel infections:
  – Score >6
  – Antibiotic therapy after culture and susceptibility results have been obtained
  – Signs of severe infection, and/or a history of S. aureus or P. aeruginosa initiation
    of empiric therapy should be considered.
  – Oral, intraperitoneal or intravenous routes
  – MRSA IV
  – Treatment duration should be 2-4 weeks
Topical S. aureus Prophylaxis

- Exit-site: 19%
- Nasal: 9%
- Nasal + Exit-site: 4%
- None: 68%

Scahefer F, Orlando 2008
Risk ratios and 95% CIs for mupirocin vs. plc or no prophylaxis in clinical trials on S. aureus-related infections

**Peritonitis**

Perez-Fontan, 1993
MSG, 1996
Thodis 1, 1998
Thodis 2, 1998
Crabtree, 2000
Casey, 2000
Overall

RR (random) 95% CI, Weight

- 0.09 (0.02-0.37), 9.5
- 0.74 (0.42-1.31), 23.4
- 0.31 (0.16-0.60), 21.6
- 0.34 (0.12-0.95), 14.3
- 0.24 (0.11-0.54), 18.5
- 0.41 (0.13-1.29), 12.8
- 0.34 (0.20-0.57)

**Exit-site infections**

Overall

RR (random) 95% CI, Weight

- 0.33 (0.15-0.71), 21.0
- 0.32 (0.18-0.55), 26.0
- 0.14 (0.04-0.47), 13.4
- 0.40 (0.14-1.13), 15.6
- 0.90 (0.47-1.69), 24.0
- 0.38 (0.22-0.67)

**All S. aureus infections**

- 0.38 (0.22-0.67)

Mupirocin prophylaxis substantially reduces the rate of SA infection in the dialysis patients

Peritonitis and ESI were found to be reduced by 66% and 62%, respectively, among PD patients

Tacconelli et al, CID 2003
First RCT
Gentamicin vs Mupirocin

- Gentamicin cream daily to the exit site was highly effective in reducing *P. aeruginosa ESI* and as effective as mupirocin cream in preventing *S. aureus ESI*

- 57% reduction in ESI
- 35% reduction in peritonitis
- Peritonitis with Gr (-) agents occurred less often using gentamicin (0.22/year vs 0.15/year, p=0.003).

Bernardini J, JASN 2005;16:539-545
• Annual dialysis conference USA
• Plan ESPN-WG: HD + PD-course