Dialysis Problems- minimising complications maximising outcomes

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Peritoneal dialysis

Prevention of peritonitis
Treatment of peritonitis
Preventing membrane failure
Chylous leaks
Pancreatitis
Peritonitis

from B. Piraino. Pediatric Nephrol 2004

- 30% of peritoneal dialysis is terminated because of problems with peritonitis (NAPRTCS)
GUIDE/INE 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).
Catheters and prevention

GUIDELINE 2 – CATHETER TYPE AND PLACEMENT

2.1 We suggest the use of a double-cuff Tenckhoff catheter with a downward or lateral subcutaneous tunnel configuration that is placed by a surgeon or nephrologist experienced in PD catheter placement (2B).

2.2 We recommend that perioperative antibiotic prophylaxis be used within 60 minutes before the incision for PD catheter placement to reduce the incidence of early-onset peritonitis (1A).

- Single cuff use – risk of gram negative peritonitis increased 13 fold
- Perioperative antibiotics- reduced risk of peritonitis and wound infections demonstrated in pediatric studies. A first generation cephalosporin is recommended (rather than vancomycin because of the problem of VRE- vancomycin resistant enterococcus
**GUIDELINE 3 – EARLY EXIT-SITE CARE**

3.1  We recommend once-weekly sterile dressing changes to the exit site, performed by experienced health personnel according to a standardized protocol, until the exit site is well healed (2B).

3.2  We recommend catheter immobilization to prevent trauma to the exit-site and to optimize early healing (1B).

- Adult ISPD guidelines from 2016 recommend topical weekly mupirocin cream to the exit site. Metanalysis found S. Aureus peritonitis rate reduced by 40% (Xu G et al NDT 2010)
- Systematic review of cleaning of exit site- no difference in exit site rates between povidone iodine and just soap and water (Cochrane review Strippoli GF 2004)
GUIDELINE 6 – ADJUNCTIVE PROPHYLACTIC ANTIBIOTIC THERAPY

6.1 We suggest that the use of oral nystatin or fluconazole be considered at the time of antibiotic administration to PD patients to reduce the risk of fungal peritonitis (2B).

6.2 We suggest prophylactic antibiotic administration after accidental intraluminal contamination to lower the risk of peritonitis (2B).

6.3 We suggest prophylactic antibiotic administration before invasive dental procedures to lower the risk of peritonitis (2D).

6.4 We suggest prophylactic antibiotic administration before procedures involving the gastrointestinal or genitourinary tract and associated with a high risk of bacteremia to lower the risk of peritonitis (2D).
<table>
<thead>
<tr>
<th>Situation</th>
<th>Indication</th>
<th>Antimicrobial</th>
</tr>
</thead>
</table>
| Presence of risk factors for fungal peritonitis | - High baseline rate of fungal peritonitis in the PD unit  
- PEG placement                                                                 | Nystatin PO 10 000 U/kg daily    |
| Touch contamination                     | - Instillation of PD fluid after disconnection of system  
- Disconnection during PD                                                                 | Fluconazole 3–6 mg/kg IV or PO  
every 24–48 hours (maximum: 200 mg) |
| Invasive dental procedures             | - Manipulation of gingival tissue or of the periapical region of teeth,  
or perforation of the oral mucosa                                    | Cefazolin (125 mg/L IP), or vancomycin (25 mg/L IP)  
if known colonization with MRSA  
Culture result, if obtained, directs subsequent therapy |
| Gastrointestinal procedures            | - High-risk procedures (esophageal stricture dilation, treatment of varices, ERCP, and PEG)  
- Other gastrointestinal or genitourinary procedures | Amoxicillin (50 mg/kg PO; maximum: 2 g)  
or ampicillin (50 mg/kg IV or IM; maximum: 2 g)  
or cefazolin (25 mg/kg IV; maximum: 1 g)  
or ceftriaxone (50 mg/kg IV or IM; maximum: 1 g)  
or clindamycin (20 mg/kg PO; maximum: 600 mg)  
or clarithromycin (15 mg/kg PO; maximum: 500 mg)  
or azithromycin (15 mg/kg PO; maximum: 500 mg)  
Cefazolin (25 mg/kg IV; maximum: 2 g)  
or clindamycin (10 mg/kg IV; maximum: 600 mg)  
or, if high risk for MRSA, vancomycin (10 mg/kg IV; maximum: 1 g)  
Cefoxitin/cefotetan (30–40 mg/kg IV; maximum: 2 g)  
Alternatives:  
Cefazolin (25/kg IV; maximum: 2 g)  
plus metronidazole (10 mg/kg IV; maximum: 1 g)  
or clindamycin (10 mg/kg IV; maximum: 600 mg)  
plus aztreonam (30 mg/kg IV; maximum: 2 g) |
GUIDELINE 7 – OSTOMY PATIENTS

7.1 The PD catheter exit site should be placed as far as possible from an ostomy site (not graded).

7.2 We recommend that gastrostomy placement should preferentially take place either before or at the time of PD catheter placement (1C).

7.3 We recommend the preferential use of an open surgical procedure for gastrostomy placement in patients who are already receiving PD. In patients not yet receiving PD, gastrostomy placement can be performed by either open surgical technique or laparoscopically (1C).

7.4 We suggest administration of prophylactic antibiotic and antifungal therapy during gastrostomy placement (2C).

7.5 We suggest withholding PD for 1 or more days after gastrostomy placement (2D).

• Higher peritonitis rates in children with gastrostomies and on PD (1 per 7.8 mths vs 1 per 18.4 mths (Ramage et al)
• IPPR: trend towards more gram negative peritonitis in patients with gastrostomies
• PLAN WELL- try and insert the gastrostomy well ahead of time before starting peritoneal dialysis
Peritonitis

• Diagnosis: Cloudy effluent and abdominal pain +/- fever, chills, vomiting, abdominal distension
• Differential diagnosis- chemical or eosinophilic peritonitis, chylosus effluent, specimen from a dry abdomen
Obtaining the peritoneal fluid sample

• If the patient has a daytime dwell, send a manual drain for cell count, differential, gram stain and culture

• If no day time dwell (dry abdomen) instill the fill volume for at least 1 hour (preferably 2) before draining out for sample. If you don’t dwell for long enough may not fulfil WCC criteria but if neutrophil count >50% suspicious
Peritoneal fluid cultures

- Centrifuge the sample and culture the sediment (rate of culture negative results <5%)
- If can’t centrifuge and culture, inoculate blood culture bottles (rate of culture negative results <20%)
- If patient lives a long way from the hospital, ask them to refrigerate (not freeze) the effluent bag until they take it to the hospital lab
- 75% of cultures will be positive by 72 hrs. If not consider yeast; consider alternative culturing techniques
- WCC > 100 mm$^3$ and neutrophil count > 50% - can make an empiric diagnosis of peritonitis. Cystospin best to analyze
- If eosinophil count > 10% and sterile culture- eosinophilic peritonitis
Higher rate of treatment failure; need to monitor antibiotic levels

SCH empiric protocol

Consider as alternative to cefazolin if MRSA or recent hospitalisation

ISPD recommends cefepime monotherapy as first line if available

**TABLE 5**

Antibiotic Dosing Recommendations\(^a\) for the Treatment of Peritonitis

<table>
<thead>
<tr>
<th>Antibiotic type</th>
<th>Therapy type</th>
<th>Loading dose</th>
<th>Continuous (^b)</th>
<th>Maintenance dose</th>
<th>Intermittent (^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aminoglycosides (IP)(^c)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Gentamicin</td>
<td></td>
<td>8 mg/L</td>
<td>4 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netilmicin</td>
<td></td>
<td>8 mg/L</td>
<td>4 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobramycin</td>
<td></td>
<td>8 mg/L</td>
<td>4 mg/L</td>
<td></td>
<td></td>
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<tr>
<td>Amikacin</td>
<td></td>
<td>25 mg/L</td>
<td>12 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalosporins (IP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Cefazolin</td>
<td></td>
<td>500 mg/L</td>
<td>125 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefepime</td>
<td></td>
<td>500 mg/L</td>
<td>125 mg/L</td>
<td></td>
<td>20 mg/kg</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td></td>
<td>500 mg/L</td>
<td>250 mg/L</td>
<td></td>
<td>15 mg/kg</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td></td>
<td>500 mg/L</td>
<td>125 mg/L</td>
<td></td>
<td>30 mg/kg</td>
</tr>
<tr>
<td>Glycopeptides (IP)(^d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td></td>
<td>1000 mg/L</td>
<td>25 mg/L</td>
<td></td>
<td>20 mg/kg</td>
</tr>
<tr>
<td>Teicoplanin(^e)</td>
<td></td>
<td>400 mg/L</td>
<td>20 mg/L</td>
<td></td>
<td></td>
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<tr>
<td>Penicillins (IP)(^c)</td>
<td></td>
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<td></td>
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<tr>
<td>Ampicillin</td>
<td></td>
<td>—</td>
<td>125 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quinolones (IP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td></td>
<td>50 mg/L</td>
<td>25 mg/L</td>
<td></td>
<td></td>
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<tr>
<td>Others</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Aztreonam (IP)</td>
<td></td>
<td>1000 mg/L</td>
<td>250 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clindamycin (IP)</td>
<td></td>
<td>300 mg/L</td>
<td>150 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imipenem–cilastin (IP)</td>
<td></td>
<td>250 mg/L</td>
<td>50 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linezolid (PO)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Metronidazole (PO)</td>
<td></td>
<td>30 mg/kg daily, divided into 3 doses (maximum: 1.2 g daily)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Rifampin (PO)</td>
<td></td>
<td>10–20 mg/kg daily, divided into 2 doses (maximum: 600 mg daily)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Antifungals</td>
<td></td>
<td></td>
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<tr>
<td>Fluconazole (IP, IV, or PO)</td>
<td>6–12 mg/kg every 24–48 h (maximum: 400 mg daily)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caspofungin (IV only)</td>
<td></td>
<td>70 mg/m(^2) on day 1 (maximum: 70 mg daily)</td>
<td>50 mg/m(^2) daily (maximum: 50 mg daily)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Treatment of peritonitis

Approximately 60% of isolated organisms are Gram positive—mostly coag neg staph and Staph aureus
2 week treatment for coag neg Staph
3 week treatment for Staph aureus
Usually responds well
Gram-negative bacteria on culture

Stop vancomycin or teicoplanin

**Pseudomonas sp.**
- Continue cefepime or ceftazidime
- Add second agent

**Escherichia coli, Proteus sp., or Klebsiella sp.**
- Continue cefepime, ceftazidime, or cefazolin if susceptible

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

**Other gram-positive bacteria**
- Treat based on susceptibilities

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### Gram-Negative Bacteria: Recommended Antibiotics and Length of Therapy

<table>
<thead>
<tr>
<th>Organism</th>
<th>Recommended antibiotics</th>
<th>Length of therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Escherichia coli, Klebsiella species</em></td>
<td>Cefepime or ceftazidime</td>
<td>2 Weeks</td>
</tr>
<tr>
<td>Resistant to third-generation cephalosporins</td>
<td>Imipenem or cefepime</td>
<td>3 Weeks</td>
</tr>
<tr>
<td><em>Enterobacter, Citrobacter, Serratia, and Proteus species</em></td>
<td>Cefepime or ceftazidime or imipenem</td>
<td>2–3 Weeks</td>
</tr>
<tr>
<td><em>Acinetobacter species</em></td>
<td>Cefepime or ceftazidime or imipenem</td>
<td>2–3 Weeks</td>
</tr>
<tr>
<td><em>Pseudomonas species</em></td>
<td>Cefepime or ceftazidime or piparacillin or ticarcillin or imipenem plus aminoglycoside or fluoroquinolone</td>
<td>3 Weeks</td>
</tr>
<tr>
<td><em>Stenotrophomonas maltophilia</em></td>
<td>Trimethoprim–sulfamethoxazole or ticarcillin–clavulanic acid</td>
<td>3 Weeks</td>
</tr>
</tbody>
</table>
Culture negative peritonitis

• IPPR- 31% of cases are culture negative
• Diagnostic dilemma: poorly culturable bacteria fungal or viral infection eosinophilic
• IPPR: Culture negative respond well to 14 days of treatment with Gm positive and Gm negative antibiotics
• If not improving by 72 hrs- special culture techniques for fungi, mycoplasma, legionella
• If clinically not improving by 5 days, remove the catheter
When should the PD catheter be removed?

<table>
<thead>
<tr>
<th>Approach to catheter</th>
<th>Indication</th>
<th>Reinsertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite removal</td>
<td>Refractory bacterial peritonitis</td>
<td>After 2–3 weeks</td>
</tr>
<tr>
<td></td>
<td>Fungal peritonitis</td>
<td>After 2–3 weeks or more</td>
</tr>
<tr>
<td></td>
<td>ESI/TI in conjunction with peritonitis with the same organism</td>
<td>After 2–3 weeks</td>
</tr>
<tr>
<td></td>
<td>(mainly <em>Staphylococcus aureus</em> and <em>Pseudomonas aeruginosa</em>; except coagulase-negative staphylococci)</td>
<td></td>
</tr>
<tr>
<td>Simultaneous removal</td>
<td>Repeatedly relapsing or refractory ESI/TI (including <em>P. aeruginosa</em>);</td>
<td>After 2–3 weeks or more</td>
</tr>
<tr>
<td>and replacement</td>
<td>relapsing peritonitis</td>
<td></td>
</tr>
<tr>
<td>Relative indication</td>
<td>Repeat peritonitis</td>
<td>After 2–3 weeks</td>
</tr>
<tr>
<td>for removal</td>
<td>Mycobacterial peritonitis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peritonitis with multiple enteric organisms because of an</td>
<td>Depends on the clinical course of the patient; after 2–3 weeks or more</td>
</tr>
<tr>
<td></td>
<td>intra-abdominal pathology or abscess; so-called surgical peritonitis</td>
<td></td>
</tr>
</tbody>
</table>

ESI/TI, Exit-site infection/tunnel infection

a Adapted from Warady et al. [12], with permission
Relapsing/recurrent peritonitis

• Relapsing = recurs < 4 weeks, same organism (5% ANZDATA 2010)
• Recurrent = recurs <4 weeks different organism
• Reinfection = recurs >4 weeks different organism

• Treat recurrent or relapsing for 3 weeks. Cefazolin is not recommended for monotherapy even based on antibiotic sensitivity (higher relapse rate)
• Consider use of urokinase in catheter – biofilm
• Consider catheter removal
Fungal peritonitis

- <2% of cases
- Risk factors- previous peritoneal antibiotics (although 50% will not have had any) ?gastrostomy
- Recommended to use fluconazole not amphotericin
  Less abdominal pain
  Better peritoneal penetration
- Always remove catheter
- Continue antifungals for 2 weeks after clinical resolution
Preventing peritoneal membrane failure

Reduction then disappearance of microvilli on mesothelial cells
Then separation of cells and exfoliation

**Strategies to prevent:**
Minimize exposure to Glc degradation products - always try to use lowest Glc concentration
Icodextrin
Aminoacid based solution
Bicarbonate buffered solutions
Other complications

Chylous leak

• Can occur because of congenital problems, post abdominal surgery
• Fatty meals increase lymphatic flow through thoracic duct
• Diagnosis: TG’s and chylomicrons in PD fluid
• Manage conservatively- use special feeds with MCT as source of fat - is absorbed directly into portal system and bypasses the intestinal lymphatics. Re-challenge every 2-3 weeks
• Can become lymphopenic - monitor for infections

Pancreatitis

• Increased risk on peritoneal dialysis
• Risk factors: hypercalcemia, hyperparathyroidism, sodium valproate
• Can present like peritonitis- fluid may be dark or haemorrhagic, clear or cloudy
• Note patients on icodextrin will not have raised levels of amylase if they have pancreatitis. If suspected and amylase level normal, check amylase on peritoneal fluid
• Lipase levels unreliable
• Can develop diabetes as complication
• Usually resolves with conservative management

Nephrology Dialysis Transplantation 20(7):1501-2 2005
Haemodialysis

AV Fistulas
Catheters- prevention and treatment of complications
Quality of life
Use of AV fistulas- less infection, morbidity and mortality.
There are no international guidelines on targets for paediatric patients for AVF

Vascular access - initial RRT
By age group 2013

AVF AVG Tunnel Catheter Non-Tunnel Catheter

Use of AV fistulas- less infection, morbidity and mortality.
There are no international guidelines on targets for paediatric patients for AVF
Fistulas first!

General principles of fistula formation

- Early referral
- Vein preservation
- Non-dominant arm first
- Start distally, work proximally
- Upper limb before lower limb
- Avoid grafts (AVG)
- Avoid central venous catheters (CVC)

Good review


- Early referral: GFR <30 or anticipate dialysis within next 6-12 months. Fistulas take longer to mature in children-mean 6 months (Sanabia Microsurgery 1993)
- Preserve veins: tell the parents and child to preserve the non-dominant arm. Venepunctures in dominant arm or hand
- Aim for radiocephalic first and try and preserve brachial for future fistulas
- AV grafts are more prone to stenosis, thrombosis and infection. Especially likely to thrombose in children with lower BP’s.
- CVC’s have a much shorter median survival in children 0.6 yrs vs 3.1 yrs for AVF (Ramage et al AM J K D 2005)
REFER YOUR PATIENTS EARLY FOR ACCESS

Vascular access - initial RRT
By referral time - Australia

- AVF
- AVG
- Tunnel Catheter
- Non-Tunnel Catheter

Early Late
How can a nephrologist help with AV fistulas?

- **Pre-op care**: no dialysis on day of surgery and avoid fluid removal prior
  - Consider stopping antihypertensives
  - Talk to anaesthetist about avoiding hypotension
  - Little evidence for oral anticoagulation
  - Set BP targets for post op care
  - 5 min daily squeeze ball- increases fistula volume size by 10%

- **When to be concerned about an existing fistula**: 20% reduction in volume flow from baseline (either on HD or doppler) or flow <400 ml/min

- **Use play therapists for cannulation**

- **Sports limitation** usually not necessary unless fistula at risk of being compressed eg with wrestling, judo
Central venous catheters-infections

Clinical Practice Guidelines for the Diagnosis and Management of Intravascular Catheter-Related Infection: 2009 Update by the Infectious Diseases Society of America

15. For suspected CRBSI, paired blood samples, drawn from the catheter and a peripheral vein, should be cultured before initiation of antimicrobial therapy, and the bottles should be appropriately marked to reflect the site from which the samples were obtained (A-II).

16. If a blood sample cannot be drawn from a peripheral vein, it is recommended that ≥2 blood samples should be drawn through different catheter lumens (B-III). It is unclear whether blood cultures should be drawn through all catheter lumens in such circumstances (C-III).
• KDOQI 2006
• 7.4.1 All catheter-related infections, except for catheter exit-site infections, should be addressed by initiating parenteral treatment with an antibiotic(s) appropriate for the organism(s) suspected. (A)

US ID Guidelines: Presumptive antibiotics: Vancomycin + Consider empiric coverage for Gm negative bacilli (4th generation cephalosporin; depends on local microbiology data) or gentamicin

Consider pseudomonas cover if neutropenic

Consider fungal cover with fluconazole if critically ill in addition

• Can use topical/oral antibiotics for catheter exit site infection
Figure 4. Catheter-related blood stream infection (CRBSI) among patients who are undergoing hemodialysis (HD) with tunneled catheters. BC, blood culture; CVC, central venous catheter; TEE, transesophageal echocardiograph.
Antibiotic locks

Also consider using antibiotic locks as prophylaxis for non-tunneled short term vascular access catheters.

<table>
<thead>
<tr>
<th>Antibiotic and dosage</th>
<th>Heparin or saline, IU/mL</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin, 2.5 mg/mL</td>
<td>2500 or 5000</td>
<td>[100, 275]</td>
</tr>
<tr>
<td>Vancomycin, 2.0 mg/mL</td>
<td>10</td>
<td>[275]</td>
</tr>
<tr>
<td>Vancomycin, 5.0 mg/mL</td>
<td>0 or 5000</td>
<td>[276, 277]</td>
</tr>
<tr>
<td>Ceftriaxone, 0.5 mg/mL</td>
<td>100</td>
<td>[123]</td>
</tr>
<tr>
<td>Cefazolin, 5.0 mg/mL</td>
<td>2500 or 5000</td>
<td>[100, 277]</td>
</tr>
<tr>
<td>Ciprofloxacin, 0.2 mg/mL</td>
<td>5000</td>
<td>[130]</td>
</tr>
<tr>
<td>Gentamicin, 1.0 mg/mL</td>
<td>2500</td>
<td>[100]</td>
</tr>
<tr>
<td>Ampicillin, 10.0 mg/mL</td>
<td>10 or 5000</td>
<td>[275]</td>
</tr>
<tr>
<td>Ethanol, 70%</td>
<td>0</td>
<td>[131]</td>
</tr>
</tbody>
</table>

**NOTE.** These antibiotic lock solutions will not precipitate at the given concentrations. Cefazolin is the preferred agent for treatment of methicillin-susceptible staphylococci, and vancomycin is the preferred agent for treatment of methicillin-resistant staphylococci. Ceftriaxone, gentamicin, or ciprofloxacin can be used for treatment of gram-negative microorganisms. Ampicillin is the preferred agent for infections due to ampicillin-sensitive *Enterococcus* species, and vancomycin is the preferred agent for treatment of ampicillin-resistant enterococci other than vancomycin-resistant enterococci. The use of an ethanol lock can be considered for the treatment of a mixed gram-positive and gram-negative infection. NA, not applicable.

* Vancomycin at 5 mg/mL is more efficacious than at 1 mg/mL in eradicating staphylococci embedded within biofilm [276]. A precipitate appears when mixing a 10 mg/mL of vancomycin with 10,000 IU/mL of heparin; however, by agitating the solution for ~10 s, the precipitation resolves and the solution remains precipitate-free for 72 h at 37°C [277]. The lock solution in 2500 IU/mL heparin can be made as follows: using vials containing 50 mg/mL of vancomycin in water, remove 2 mL and dilute in 8 mL 0.9% NaCl, resulting in 10 mg/mL of vancomycin. Place 1 mL of 5000 IU/mL heparin in a glass test tube and mix with 1 mL of the 10-mg/mL vancomycin solution (B. J. Rijnders and R. Mathot, personal communication).
• 7.4.3 Catheters should be exchanged as soon as possible and within 72 hours of initiating antibiotic therapy in most instances, and such exchange does not require a negative blood culture result before the exchange. (B) Follow-up cultures are needed 1 week after cessation of antibiotic therapy (standard practice).
Remember good exit site catheter care has been shown to reduce the risk of bacteremia by 4 fold

- E 1. CRB prophylaxis protocol
- 1. Individually wrap both of the catheter hubs with gauze saturated with povidone-iodine solution for 5 minutes prior to the removal of the caps.
- 2. Both the patient and the nurse doing the dialysis hook-up must wear a mask during the entire time that the catheter is being manipulated. A face shield will not suffice.
- 3. The nurse must wear a fresh pair of disposable gloves for the hook-up procedure.
- 4. As soon as the cap is removed from the hub, the surface that was covered by the cap must be wiped with a povidone-iodine pledget.
- 5. The catheter hubs must be connected immediately. They must never be allowed to remain exposed to the air.
- 6. This procedure must be repeated at the time the patient is disconnected at the end of dialysis or for any other reason.
- 7. Catheter manipulation must be kept to an absolute minimum.
- If there are flow problems they must be definitively addressed as quickly as possible.

The incidence of CRB fell from an average level of 6.97 per 1000 catheter-days during the control period to an average of 1.68 during the study period
Beathard GA et al Sem in Dialysis 2003
Catheter malfunction

Dysfunctional Catheter

Thrombotic occlusion suspected due to one or more of the following:
- BFR ≤ 300 mL/min sustained over first and last 30 min of Tx
- >10% ↓ Qₐ from baseline
- Kt/V < 1.2
- Arterial pressure ≲ 250 or venous pressure ≥ 250 mm Hg to achieve BFR > 300 mL/min
- Failure to aspirate

New Catheter (<2 wks old)

1st occurrence

Trendelenburg

(needed to achieve BFR > 300 mL/min)

Catheter malposition suspected?

Yes

Flow restored?

Yes

Reverse Lines

Flow restored?

No

Old Catheter (>2 wks old)

Acute: 1st occurrence or 2 consecutive weeks w/o requiring "evaluation of lines/machines"

Chronic: Previous dialysis sessions have successfully occurred but required "evaluation of lines/machines"

Dialysis

Flow restored?

IPA

Flow restored?

Yes

IR

No

IPA

Flow restored?

Yes

Dialysis

KDOQI guidelines 2006
Catheter thrombosis

• Most common cause of malfunction
• Randomised trial data using alteplase (tissue type plasminogen activator) shows reduced clot incidence and reduced bacteremia in adults (Hemmelgam BR BMC Neph 2006, NEJM 2011, Schenk AmJ K Dis 2000) and in children (Gittins NS Arch Dis Child 2007). In the paediatric trial once they change to alteplase the incidence of blocked lines decreased from 2.7 to 1.2 per year and no need for surgical replacement.
Alteplase can be aliquoted and frozen to make it cheaper

- alteplase has been shown to be stable when stored at −20°C for up to 6 months.
- Dose used in paediatric trial alteplase 1 mg/ml, using a volume approximately 0.2 ml larger than the lumen volumes. The alteplase was drawn up into 2 ml syringes and stored at −20°C before use. Arch Dis Child 2007;92:499-501
Quality of life issues for children on dialysis
Outcomes

- Impact of Renal Replacement Therapy in Childhood on Long-Term Socioprofessional Outcomes: A 30-year Follow-Up Study J Pediatrics April 2016 Lidwien A et al
  All commenced RRT age <15 years between 1972-1992
- Less likely to be employed than age matched population (62.5% vs 81%)
- Less likely to have a child (28.8% vs 64.8%)
- Comorbidities, short stature, dialysis were associated with adverse outcomes
Dialysis – major burden for families

• Caregivers of children with CKD have increased levels of psychological stress and reduced QOL (A. Tong et al Child Care Health Dev 2010)

• Parents of children on dialysis have an inability to sustain employment, profound socioeconomic impact (M. Medway AJKD 2015)

• KCAD study- prospective Australian study of children with CKD Poor self-rated parental health was predictive of poor-self rated health in children with CKD (OR 42.7, 95%CI 5-300, p=0.006).
Quality of life in children

- Studied well in adults not in children
- Are some QOL tools for paediatrics but few disease specific for ESKD (review-Perit Dial Int 2009; 29(S2):S190–S191by W-M Lai)
- Better QOL with transplant vs dialysis (Furth SL 2001, Goldstein 2006)
- Korean study from registry : PD had better QOK than HD. No difference between PD and transplant in total QOL scores Park KS 2012 (adapted Peds QL)
- Hong Kong- Chiu MC et al (adapted Peds QL) No difference in scores between APD and transplant except follow up study found lower scores in sleep with APD Perit Dial Int 2007
• Multicentre Study of Treatment Outcomes in Australian Adolescents and Young Adults Commencing Dialysis. Nephrology 2016 Krischock L et al- significantly less children on HD attended school fulltime than children on PD Hospital in the school- education while on HD
The best treatment involves a team that includes social workers, psychologists, dietitians, access to teachers, specialised nurses so the family and the child can emerge ‘whole’