Infectious Diseases Society of America
Emerging Infections Network

Report for Query:
‘Antimicrobial Lock Prophylaxis and Treatment of Catheter-Related Bloodstream Infections’

Overall response rate: 606/1084 (55.9%) physicians responded from 9/26/07 to 11/5/07. Note: Not all respondents answered all questions, so totals for individual questions vary.

Responders as percent of overall members in each category:
Practice: Adult 434 (55% of 794 members)
Pediatrics 135 (62% of 218 members)
Both 37 (52% of 71 members)

Antimicrobial Lock Prophylaxis
Question 1. Use antimicrobial lock prophylaxis?
Never use 488 (81%)
Use 118 (19%)
Selectively 102 (17%)
Regularly 16 (2%)

Use of antimicrobial lock prophylaxis did not vary by practice (peds vs. adult)

Question 2. Types of IV catheters for which prophylaxis used (N=118):

<table>
<thead>
<tr>
<th>Catheter Type</th>
<th>Routinely</th>
<th>Under special circumstances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuffed/tunneled catheters</td>
<td>13 (11%)</td>
<td>81 (69%)</td>
</tr>
<tr>
<td>Hemodialysis catheters</td>
<td>12 (10%)</td>
<td>57 (48%)</td>
</tr>
<tr>
<td>Ports/implanted catheters</td>
<td>11 (9%)</td>
<td>69 (58%)</td>
</tr>
<tr>
<td>Short-term central venous catheters</td>
<td>2 (2%)</td>
<td>24 (20%)</td>
</tr>
<tr>
<td>PICC lines</td>
<td>1 (0.8%)</td>
<td>27 (23%)</td>
</tr>
<tr>
<td>Other (“all neonatal lines”)</td>
<td>1 (0.8%)</td>
<td>0</td>
</tr>
</tbody>
</table>

Question 3a. Most frequently used agents for antimicrobial lock prophylaxis (provided by 97 members):

<table>
<thead>
<tr>
<th>Agent</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin + heparin</td>
<td>45 (46%)</td>
</tr>
<tr>
<td>Vancomycin alone</td>
<td>21 (22%)</td>
</tr>
<tr>
<td>Ethanol</td>
<td>9 (9%)</td>
</tr>
<tr>
<td>Vancomycin + gentamicin +/- heparin</td>
<td>6 (6%)</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>Doxycycline + heparin or EDTA</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>Other protocols</td>
<td>9 (9%)</td>
</tr>
</tbody>
</table>
Question 3b. Antimicrobials you have used? (check all that apply) [answered by 113 members]

<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>Concentration(s), if stated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancomycin</td>
<td>25-50 mcg/ml (N=6); 0.5-5mg/ml (N=11); 10-100mg/ml (N=2)</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>5mcg/ml (N=1); 1-5mg/ml (N=5); 13.3mg/ml (N=1)</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>2mcg/ml (N=2)</td>
</tr>
<tr>
<td>Mino- or doxycycline</td>
<td>3mg/kg (N=1)</td>
</tr>
<tr>
<td>Tigecycline</td>
<td>50mg/ml (N=1)</td>
</tr>
<tr>
<td>Daptomycin</td>
<td>5gm/ml (N=1)</td>
</tr>
<tr>
<td>Rifampin</td>
<td></td>
</tr>
<tr>
<td>Amphotericin B</td>
<td>25% (N=4); 70% (N=7); 73% (N=1); 100% (N=2)</td>
</tr>
<tr>
<td>Ethanol</td>
<td></td>
</tr>
<tr>
<td>Cephalosporin*</td>
<td>25% (N=4); 70% (N=7); 73% (N=1); 100% (N=2)</td>
</tr>
<tr>
<td>Other†</td>
<td>25% (N=4); 70% (N=7); 73% (N=1); 100% (N=2)</td>
</tr>
</tbody>
</table>

*Cefazolin (N=7), ceftazidime (N=3), ceftriaxone (N=2), cefepime (N=1)
†Mentioned by 1 member each.

Question 3c. Routinely use anticoagulants?

- No 46 (39%)
- Yes 72 (61%), Heparin cited by 61; EDTA or citrate by 2; Both by 7

Question 4. Most common organisms causing breakthrough bacteremias among those using ALT (in rank order):

Listed for Organism 1 (87 responses):
- Coagulase-negative staphylococci 35 (40%)
- *S. aureus* (includes specification of MRSA, MSSA) 27 (31%)
- “Staph” 3 (3%)
- Gram-negative rods (incl. *E. coli*) 7 (8%)
- “Don’t know” or “Haven’t had a failure” 7 (8%)
- Yeast or *Candida* spp. 6 (7%)
- *Acinetobacter* spp. 2 (2%)

Listed for Organism 2 (50 responses):
- Coagulase-negative staphylococci 13 (26%)
- *S. aureus* (includes specification of MRSA, MSSA) 10 (20%)
- Enterococci 8 (16%)
- Gram-negative rods (incl. *Klebsiella, E. coli*) 7 (14%)
- Yeast or *Candida* spp. 5 (10%)
- Pseudomonas 4 (8%)
- Diphtheroids or *Corynebacterium* spp. 2 (4%)

Listed for Organism 3 (27 responses):
- Gram-negative rods (includes *Klebsiella*) 9 (33%)
- Coagulase-negative staphylococci 5 (19%)
- Yeast or *Candida* spp. 5 (19%)
- Enterococci 4 (15%)
- *Pseudomonas* or *Acinetobacter* spp. 2 (8%)
- *S. aureus* or MRSA 2 (8%)
**Antimicrobial Lock Treatment (ALT)**

**Summary Table** for 387 members responding to these questions, No. (%)

<table>
<thead>
<tr>
<th>Attempt catheter salvage?</th>
<th>If yes, do you use ALT?*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any organism</td>
<td>344 (89)</td>
</tr>
<tr>
<td>Coag-negative staph only</td>
<td>336 (87)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other (non-CoNS) organisms combined</th>
<th>270 (70)</th>
<th>127 (47)</th>
</tr>
</thead>
</table>
| *Denominator for this column is the number who attempt catheter salvage (1st column)*

*Neither catheter salvage nor use of ALT varied by practice (peds vs. adult)*

**Question 5. Do you attempt catheter salvage?** No. (%) [answered by 387 members]

<table>
<thead>
<tr>
<th>Neatly</th>
<th>Often</th>
<th>Rarely</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV only</td>
<td>IV+ALT</td>
</tr>
<tr>
<td>CoNS</td>
<td>51 (13)</td>
<td>132 (34)</td>
</tr>
<tr>
<td>S. aureus</td>
<td>191 (50)</td>
<td>27 (7)</td>
</tr>
<tr>
<td>Enterococcus spp.</td>
<td>192 (50)</td>
<td>49 (13)</td>
</tr>
<tr>
<td>Enterobacteriaceae</td>
<td>201 (52)</td>
<td>59 (15)</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>262 (68)</td>
<td>26 (7)</td>
</tr>
<tr>
<td>Acinetobacter spp.</td>
<td>279 (72)</td>
<td>27 (7)</td>
</tr>
<tr>
<td>Candida</td>
<td>343 (89)</td>
<td>3 (0.8)</td>
</tr>
</tbody>
</table>

*Attempting treatment with ALT only was selected by <1% of members for each organism (data not shown).*

**Question 6. ALT agents and mechanics of instillation used for treatment:**

**Coagulase-negative staphylococci** [171 members responded]

- Vancomycin alone: 133 (78%)
- Vancomycin + heparin: 13 (8%)
- Vancomycin + another antimicrobial*: 6 (4%)
- Ethanol or ethanol + heparin: 5 (3%)
- Vancomycin +/- gentamicin: 4 (2%)
- Vancomycin or cefazolin: 2 (1%)
- Daptomycin: 4 (2%)
- Other (by 1 member each): 6 (4%)

*oral or IV rifampin, cefazolin, gentamicin, ethanol, minocycline

Mechanics of ‘vancomycin alone’ ALT therapy:

**Therapy Duration:** [provided by 79 members]

- 10-14 days: 55 (70%)
- 14-28 days: 5 (6%)
- 5 days: 4 (5%)
- 7-10 days: 8 (10%)
- 7-14 days: 2 (3%)
- ‘As long as possible’: 1 (1%)

**Daily dwell time:** [provided by 86 members]
Less than 1 hour  3 (3%)
At least 1 hour  17 (20%)
2 to <6 hours  9 (10%)
6-12 hours  29 (34%)
>12 to 24 hours  10 (12%)
‘Between uses of line’  18 (21%)

*S. aureus* [99 members responded]
- Vancomycin  68 (68%)
- Vancomycin + heparin  7 (7%)
- Vancomycin or cefazolin  8 (8%)
- Cefazolin  4 (4%)
- Ethanol  3 (3%)
- Beta lactams when possible, otherwise vancomycin  2 (2%)
- Other (by 1 member each)  7 (7%)

Mechanics of ‘vancomycin alone’ ALT therapy:
- Therapy Duration: [provided by 42 members]
  - 10-14 days  24 (57%)
  - 14-28 days  5 (12%)
  - 28-56 days  3 (7%)
  - 5 days  2 (5%)
  - 7-10 days  5 (12%)
  - ‘Same duration as systemic ABX’  2 (5%)
  - ‘As long as possible’  1 (1%)
- Daily dwell time: [provided by 41 members]
  - At least 1 hour  10 (24%)
  - 2 to <6 hours  3 (7%)
  - 6-12 hours  14 (34%)
  - >12 to 24 hours  5 (12%)
  - ‘Between uses of line’  9 (22%)

*Pseudomonas spp.* [38 members responded]
- An aminoglycoside (primarily gentamicin)  19 (50%)
- Cipro or gentamicin  5 (13%)
- Ceftazidime  4 (11%)
- Ethanol  2 (5%)
- Ciprofloxacin  2 (5%)
- Other (by 1 member each)  6 (16%)

Mechanics of aminoglycoside ALT therapy (includes top two categories above):
- Therapy Duration: [provided by 12 members]
  - 10-14 days  8 (67%)
  - 28 days  1 (8%)
  - 7-10 days  3 (25%)
- Daily dwell time: [provided by 13 members]
  - At least 1 hour  5 (38%)
  - 8-12 hours  4 (31%)
  - 24 hours  1 (8%)
  - ‘Between uses of line’  3 (23%)
Candida spp. [11 members responded]

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphotericin</td>
<td>7 (64%)</td>
</tr>
<tr>
<td>Ethanol</td>
<td>2 (18%)</td>
</tr>
<tr>
<td>Ambisome</td>
<td>1 (9%)</td>
</tr>
<tr>
<td>Fluconazole</td>
<td>1 (9%)</td>
</tr>
</tbody>
</table>

Mechanics of amphotericin/Ambisome ALT therapy:

<table>
<thead>
<tr>
<th>Therapy Duration</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-14 days</td>
<td>1 (20%)</td>
</tr>
<tr>
<td>14 days</td>
<td>3 (60%)</td>
</tr>
<tr>
<td>28 days</td>
<td>1 (20%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Daily dwell time</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least 1 hour</td>
<td>1 (25%)</td>
</tr>
<tr>
<td>8 hours</td>
<td>2 (50%)</td>
</tr>
<tr>
<td>‘Until next use of line’</td>
<td>1 (25%)</td>
</tr>
</tbody>
</table>

Comments by members: We had a (very welcome) substantial increase in the number of comments. Rather than lengthening this report substantially, we elected to put most comments in a separate document (view at: http://www.int-med.uiowa.edu/research/ein/ALT_Comments.pdf). Highlights include a number of comments about the need for more data from prospective trials. Some members cited concerns about the development of resistance. Others mentioned successes or failures with individual cases or organisms. In general, members who used ALT for treatment seemed most comfortable using it with coagulase-negative staphylococcal infections, and the use of ALT for treatment of other organisms often seems to be reserved for patients with limited IV access options. Selected comments are included below.

Specific comments about Candida spp.:
- Always pull catheters/never attempt salvage for Candida spp. BSI [by 6 members]
- We have data on 4 pts involving 6 episodes of candidemia. Only chose pts w/o significant systemic symptoms & who had limited IV access who require long-term TPN (short gut, in particular) using modified Costagnola technique success in 4 of 6 episodes. Success achieved with C. albicans (1), C. glabrata (2), and C. guillermondi (1); failure occurred with only case of C. parapsilosis and case with both C. albicans & C. glabrata simultaneously. Pts w success stayed fungus culture-negative minimum of 4 months. Pts received Ambisome lock for ~8hrs & also got systemic therapy (Ambisome, fluconazole or caspofungin, depending upon physician) once lock completed daily. Cultures obtained daily prior to lock until negative x 2-3, then every other day until lock stopped.
- I have out of desperation used amphotericin B lock for candidemia, but both times the line stopped drawing and I had to pull line anyway.
- I have used ampho B lock (with systemic therapy as well) once in a child when line could not be removed (Broviac). The fungemia cleared.

Compatibility/pharmacy issues
- There is a concern with potential incompatibility of vancomycin and heparin solution for purposes of lock and precipitation of the meds from solution.
- Some of the agents that might be preferred for lock solutions to treat catheter infection are not compatible with heparin or EDTA (or at least data supporting compatibility are not available).
- Chemical compatibilities have made pharmacies very slow to adopt standard protocols for ALT
• My pharmacy has demonstrated to me that gentamicin precipitates when mixed with heparin (at room temp), so I've never used this combination, although there are some published experiences with it.

• I can't get my pharmacist to add heparin to vancomycin due to compatibility concerns without a struggle.

• I have avoided ALT in our institution since we have had reports from pharmacy that vancomycin and heparin precipitate when mixed. Perhaps they are mixing incorrectly but I do not want to take chances until a commercial product is available.

**Specific comments about ethanol locks:**

• If I had my way, I would use 50% ethanol in any deep line, especially in outpatient PICCs.

• Our hospital is really 2 hospitals in one building. We have dealt with line sepsis issues in the standard short term acute care with education, chloroprep, and the biopatch. In the LTAC (long term acute care), we found that line sepsis was our principal nosoc. infection. Went down the above path, but still had issues. Since adding daily ethanol locks we have seen a very dramatic reduction in line sepsis and have had no complications. We feel LTACs are at increased risk for line infections as a result of a much longer length of stay, and line times of 3-5 weeks, in the setting of post surgical pts, TPN and known pt colonization with MDRO

• Some ID physicians in my hospital system are using EtOH as a lock for prophylaxis or adjunct to clear a line infection, with systemic abx. There are some published experiences with this and other non-antibiotic agents. It would be interesting to compare these agents with other, more standard approaches to see if they could be helpful and perhaps decrease line infections, improve line salvage and decrease antibiotic exposure.

• It is well known that ethanol is not safe for polyurethane catheters, but I am currently attempting to salvage a polyurethane Bard mediport with ethanol.

• Confusion in primary care physicians, nurses, and pharmacists about the details of this therapy led to one patient getting 10% ETOH instead of 70% (suspect that handwritten 7 was interpreted as 1). He experienced breakthrough bacteremia with MSSA. We suspect that the ETOH concentration at 10% was not high enough to be bactericidal.

**Comments about and barriers to antimicrobial lock therapy**

• More home infusion education. Some get confused if patient is receiving both IV and lock solutions of vancomycin.

• We generally treat using traditional IV pulse therapy for 1 week and then switch to dwell therapy for another week or permanently depending on the case. We have not yet drawn conclusions regarding efficacy of these practices other than to say that the management is easier, allowing earlier discharge and less systemic antibiotics and has resulted in no greater incidence of infection. We have had breakthrough infections which are hard to classify, particularly in our short guts where bacteremias often occur from systemic causes.

• Main stumbling block to the use of ALT seems to be the need to use the port.

• The issue is more complicated in pts on continuous TPN and/or fluids

• Has been very difficult to arrange for ALT treatment in our hospitalized patients. It is often given at different times, so requires fairly complicated order sets. The heparin concentration may be different, depending on the type of catheter.

• Dosing and nursing compliance is a major issue. While in theory it is very useful, it is a challenge clinically. IV's are constantly utilized. There is also very little guidance available. Pharmacists are not familiar with dosing and nurses still flush the ports. Great survey!

• The few times I have tried it, I have run into resistance from others: nephrologists & dialysis nurses wanting a formal protocol with published guidelines, pharmacists uneasy about mixing solutions.