Management of Biofilm

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The problem
Why can biofilms not be removed? Because they are extremely tolerant.

Live/dead stain of antibiotic treated biofilm

Paralysis of neutrophils (white blood cells)
Biofilms and antibiotics

Traditional Antibiotic treatment

Biofilm effect

Planktonic effect

Time after administration

Antibiotic concentration
Biofilm cells tolerate high doses of antibiotics

Table I. Susceptibility in vitro of planktonic and biofilm cells of non-mucoid and mucoid *P. aeruginosa* to piperacillin and tobramycin.

<table>
<thead>
<tr>
<th></th>
<th>Planktonic cells</th>
<th>% survival after 4–5 h</th>
<th>Young biofilm (2 days)</th>
<th>Old biofilm (7 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NM*</td>
<td>M**</td>
<td>NM</td>
<td>M</td>
</tr>
<tr>
<td>Piperacillin 200 µg/mL</td>
<td>4%</td>
<td>4%</td>
<td>5–10%</td>
<td>5–10%</td>
</tr>
<tr>
<td>Tobramycin 10 µg/mL</td>
<td>0.001%</td>
<td>0.001%</td>
<td>0.001%</td>
<td>2%</td>
</tr>
<tr>
<td>Piperacillin 200 µg/mL + Tobramycin 10 µg/mL</td>
<td>&lt; 0.001%</td>
<td>&lt; 0.001%</td>
<td>&lt; 0.001%</td>
<td>0.1–0.01%</td>
</tr>
</tbody>
</table>

1. Inocula, 10^8 CFU/mL. MIC tobramycin: 1 µg/mL, MIC piperacillin: 16 µg/mL. Modified from [126]. * NM: non-mucoid. ** M: mucoid.
Silver sulfadiazine (SSD)
Silver sulfadiazine (SSD)

Planktonic silver sulfadiazine kill

µg/ml silver sulfadiazine

CFU/ml
Physical disruption revert the tolerance

- increasing tolerance to antibiotics by 24 h - become resistant by 48/72 h
- Treatment window with antibiotics up to 24h following debridement
- Antibiotic failure against mature (>48 h) biofilms
- Factor into treatment regimes and test model interpretation

Wolcott et al. (2010)
Biofilms in chronic wounds

NB biofilms CANNOT be observed macroscopically

Bjarnsholt et al; Wound Repair and Regeneration, 2008 Jan-Feb;16(1):2-10.
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