Portsmouth Audit
Discussion - February 2007

Management of infection in Total Hip and Knee Arthroplasty

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An Interdisciplinary Challenge

- Many aspects of Rx controversial
  - Diagnosis
  - Role of debridement & washout
  - 1 stage vs 2 stage revision
  - Local vs systemic antibiotics
Incidence of deep infection

- Varies significantly between centres
- Quoted averages range 0.6 – 2%
Treatment Options

- Tailor to individual
  - Operative vs suppressive
Pathophysiology 1

- **DIRECT**
  - Access of bacteria from pt, theatre, personnel
  - At time of surgery or early post-op

- **HAEMATOGENOUS**
  - Bacteraemic event at remote site
  - Can happen at any time

*Note: Both significantly modulated by patient factors*
Prime Suspects

- Staphylococci most commonly isolated organisms
- *Epidermidis* > *Aureus*
- Others: Strep
  - Enterococci
  - Gram + cocci
- Rare: Gram negative
  - Fungi & Mycobacteria
The Race for the Surface

- Host tissue vs bacteria to colonise implant surface.
- Prosthesis immediately coated with host derived “conditioning film”.
- Film acts as media for colonisation (host vs pathogenic)
- Bacteria approach TJA through interaction of physical & chemical forces
Pathophysiology 2

- If bacteria win race they will bind & multiply
- Prosthesis inert with no innate protection

\[ S. \text{aureus} = \text{Affinity for metal alloys} \]
\[ Pseudomonas = \text{Prefers polymers} \]

- Abx can also interact with implant surface to inhibit bacterial adherence
The Glycocalyx & Antibiotic Resistance

- Most infecting organisms produce Glycocalyx
  - Enhances nutrition
  - Exopolysaccharide barrier to host defences
  - Bacterial sequestration

- Result: Decreased antibiotic penetration
  Increased antibiotic resistance

*Esp: S. aureus, CNS e.g. S. epidermidis & Pseudomonas spp*
Pre-operative diagnosis of deep infection

- Hx & Exam both highly variable (IV/C)
- Mostly mild-moderate pain
- Less frequently:
  - Deep throbbing pain
  - Wound drainage
  - Erythema
  - Swelling
  - Systemic fever, chills, malaise
Initial Investigations

- Plain radiographs (IIb/B)
- FBC + diff (IIb/B)
- ESR (IIb/B)
- CRP (IIb/B)
ESR & CRP 1

- Non specific indicators of systemic response to inflammatory processes
- ESR can remain elevated for 1 yr post THA
- CRP returns to baseline @ ~3/52 post-op (range 1-8/52)

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
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<tbody>
<tr>
<td>ESR (&gt;30)</td>
<td>0.82</td>
<td>0.85</td>
<td>0.58</td>
<td>0.95</td>
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<tr>
<td>CRP (&gt; 10)</td>
<td>0.96</td>
<td>0.92</td>
<td>0.74</td>
<td>0.99</td>
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<tr>
<td>ESR + CRP</td>
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<td></td>
<td>0.83</td>
<td>1.00</td>
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ESR & CRP 2

- NPV of a low ESR (~95%) more useful than raised ESR (PPV 58%)
- Accuracy optimised with:
  - Combination ESR + CRP
  - Serial measurements
Radiographic Findings

- Rarely diagnostic
- Important to rule out other sources of pain (e.g. #, HO, prosthesis failure)
- Infection suggested by radiolucent lines, osteolysis and scalloping or periosteal new bone formation
- Speed of progression: Septic > Aseptic
Radio-isotope scanning (IIb/B)

- Can be useful if prosthesis > 18/12
- False Neg when infective process interferes with local blood supply
- Addition of Ga 67 citrate > Tc 99-m alone.
Aspiration / Biopsy (IIb/B)

- Allows pre-op Δ of infective organism
- Note: Barrack paper (JBJS 1993). Advises against aspirn in all revision cases
- High PPV but less useful if prosthesis > 5ys or if normal bloods
- Remember to stop Abx 2-3/52 before
- Aspirn = Bx (Williams 2004)

<table>
<thead>
<tr>
<th>Author</th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tr>
<td>Elson 1991</td>
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<td>Roberts 1992</td>
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<td>Lachiewicz 1996</td>
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<td>Spangehl 1999</td>
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<td>Williams 2004</td>
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<td>94</td>
</tr>
<tr>
<td>Av</td>
<td>86</td>
<td>93</td>
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</tbody>
</table>
Others

- Frozen Section (IIb/B):
  - Supplements surgical specimens
  - 10 PMN / HPF = Sens 84%, Spec 99%

- PCR (IIb/B):
  - Pros: Allows detection in small numbers
  - Cons: Cost, no sensitivities, does not identify primary agent among mixed growth
Interventions 1 – Surgical Debridement

- Depends on timing:
  - $\leq 3/52 = 84\%$ success
  - $3-6/52 = 56\%$

- Note:
  - Infected THR tend to present later than TKR
  - Haematogenous infection often delayed c.f direct
Interventions 2 – Surgical prosthesis exchange

- 1 vs 2 stage
- Best chance of maximising function & clearing infection
- Vital that micro is as accurate & comprehensive as poss
  - 5x tissue specimens (new scalpel + forceps for each)
  - Early transfer of specimens to lab
  - Withold intra-op Abx until samples obtained
Direct Exchange (III/B)

- Improved efficacy cf debridement alone
- Avoids morbidity of temporary pseudarthrosis & 2nd major procedure
- No opportunity for soft tissue contracture
- Improved outlook if good bone stock

- BUT
- Less successful than 2 stage esp with virulent / resistant organisms (Ure K J et al JBJS Am 1998)
Staged Exchange (III/B)

- Gold Standard?
- Local antibiotics +/- systemic (patchy evidence for length of time with systemic Rx)
- 2 stage exchange with antibiotic spacer success > 90% (Langlais F et al In: EFORT 2003)
Spacers

- **Aims:**
  - Preserve normal relationship between structures
  - Vector for local antibiotic Rx
  - Allow reasonable attempts @ mobilisation
  - Facilitate exposure @ reconstruction
  - Straightforward to remove
Antibiotics 1 (III/B)

- Systemic +/- local

- Supplementary based on sensitivity profiles
  - Aminoglycosides e.g. Gentamicin
  - Glycopeptides e.g. Vancomycin

- Theoretical risk of lowering mechanical strength of cement with addition of Abx

- *In vivo* studies suggest no decrease in strength at 13 yrs with 10% substitution (e.g. 4g Vanc / 40g Palacos)

*Main aim is to eradicate infection. Sterile mechanical failure preferable to septic failure*
Antibiotics 2

- Heat of cement exothermic reaction inactivates penicillins
- Rifampicin interferes with cement polymerisation itself
Timing of Re-implantation

- Guided by:
  - Clinical progress
  - Serial ESR, CRP
  - ? Neg joint aspirate/open biopsies after stopping Abx
Cemented or Uncemented Prostheses? (III/B)

- Antibiotic impreg cement recommended for single stage exchange
- Cement not mandatory for 2 stage model

<table>
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<tr>
<th>% Success</th>
<th>Direct Exchange</th>
<th>Two-stage Revision</th>
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<tr>
<td>Antibiotic-loaded cement</td>
<td>86</td>
<td>93</td>
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<tr>
<td>No antibiotic</td>
<td>59</td>
<td>86</td>
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Comparison of success rates for staged revision & the use of antibiotic-loaded cement in 1641 patients collated from a number of individual studies (Langlais 2003)
Recommendations – Not controversial

- Multidisciplinary approach
- Accurate culture & sensitivity reports
- Antibiotics tailored to sensitivities of infecting organism
- Effective debridement is key
- Tissue cultures if surgical procedure performed
- Local antibiotics +/- systemic improves clearance
Ongoing Debate

- Limitations of debridement & washout
- Role for direct exchange
- Acceptability of extra morbidity assoc with 2 stage exchange
- Number of surgical attempts to clear infection before micro-organism deemed unobtainable
Thank you