Infected Total Hip Replacement

M.C. Solan
Kingston
THR and Infection

Background

Prevention

Diagnosis

Treatment
THR and Infection

Key References

Hanssen AD and Rand JA
Evaluation and treatment of infection at the site of a total hip or knee arthroplasty (Instructional Course Lecture)
JBJS (June 1988) 80-A 910-922

McDonald DA
The infected joint replacement: Prevention diagnosis and treatment
Current Orthopaedics Jan 1995

Wroblewski BM
Revision Surgery in Total Hip Arthroplasty
Springer Verlag 1990
THR and Infection

Key References

Garvin KL and Hanssen
Infection after Total Hip Arthroplasty
(Current Concepts Review)
JBJS Am 77-A (10) October 1995

Gillespie WJ
Prevention and Management of Infection after Total Joint Replacement
Clinical Infectious Diseases 1997;25: 1310-17
THR and Infection

Background
THR and Infection

Incidence

All figures underestimate

**Charnley**

9%

1%

*Swedish National Register* of Revised Failures 1979-90

0.9% at 10 years (for operations in 1979)
THR and Infection

**Incidence**

All figures underestimate

UK 50,000 cases / year

500 infected cases

£16 million / year
THR and Infection

Prevention
THR and Infection

Factors

Host
Wound
Technique
Microbiological
Theatre environment
THR and Infection

Host Factors

Increasing infection risk

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of cases</th>
<th>Deep infection</th>
<th>Reference</th>
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<tbody>
<tr>
<td>Osteoarthritis</td>
<td>994</td>
<td>1.5</td>
<td>Lynch et al. (1987)</td>
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<td>Rheumatoid arthritis</td>
<td>70</td>
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<td>Psoriasis</td>
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<td>66</td>
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<td>Monon et al. (1983)</td>
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<td>Urinary retention; urethral instrumentation</td>
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<td>Wroblewski and del Sel (1986)</td>
<td>6.2</td>
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<tr>
<td>Previous hip surgery</td>
<td>127</td>
<td>11.8</td>
<td>Echeverri et al. (1988)</td>
<td>11.8</td>
</tr>
</tbody>
</table>
THR and Infection

**Diabetes**

Moeckel et al Total hip arthroplasty in patients with diabetes mellitus
J Arthroplasty 193 8 (3) 279 - 284

No increased infection or losening
Higher rate of medical problems (UTI - MI)
THR and Infection

Microbiology
Infecting organisms unchanged since 1960’s.

50% G+ cocci

Charnley
MRC
Swedish Register
THR and Infection

**Pre-operative measures**
- Nutrition (over and under)
- Diabetes
- Skin infection
- Medications
- Dental sepsis
- Urinary infection
THR and Infection

Peri-operative measures

Reduce wound contamination

or

Prevent infection by contaminating organisms
THR and Infection

Peri-operative measures

Importance of air quality and related factors in the prevention of infection in orthopaedic implant surgery.

THR and Infection

Peri-operative measures

Reduce wound contamination:

- Laminar Flow
- Gowns
- UV Light
THR and Infection

Peri-operative measures

Race for the surface

Gristina et al Bacterial adherence to biomaterials and tissues
JBJS 67-A 264 - 273 (1985)
THR and Infection

Reducing Airborne Bacteria

Colony Forming Units (CFU’s)
10 can lead to infection

98% bacteria contaminating a wound are from air - personnel clothing ventilation
THR and Infection

**Theatre discipline**

Reduced movement in Theatre proven to reduce circulating CFU’s

Borst M et al Operating room surveillance: a new approach in reducing hip and knee prosthetic wound infections
THR and Infection

Clean Air
Lidwell et al MRC prospective RCT

Flaws: Different directions of laminar flow
Inconsistent body suit use
No stratification of patients
THR and Infection

**Clean Air**


Lidwell et al MRC prospective RCT

8055 arthroplasty (hip and knee)

19 hospitals

No antibiotics

**Ultraclean air** - reduction in infection

(p<0.001)
THR and Infection

**Clean Air**
Laminar flow

Vertical better than horizontal
High Efficiency Particulate Air (HEPA) filter

Appropriate monitoring annual after HEPA change if doubt
THR and Infection

**Clean Air**

- Laminar flow
- Temperature sensitive
- High Temp leads to "Swirls"
- Increases wound contamination
- Turn it off!
THR and Infection

UV Light

Irradiation 254nm(UVC)
Favorable comparison with Laminar flow

Cost effective
THR and Infection

UV Light

Deserves further investigation
THR and Infection

Peri-operative measures
Adhesive drapes

Widely used
Unclear value

*Increased* skin surface flora (Katthagen et al 1992)
Increase costs
THR and Infection

Peri-operative measures

Reduce infection by contaminating organisms:

Patient selection
Antibiotics
THR and Infection

Peri-operative measures

Antibiotics

Gillespie WJ
Prevention and Management of Infection after Total Joint Replacement
Clinical Infectious Diseases 1997;25: 1310-17

Meta-analysis
THR and Infection

**Antibiotics** - Meta-analysis

4 RCT’s 10 - 25 years ago

**Antibiotics (48hrs - 2 weeks) vs Placebo / Nil**

Odds Ratio 0.24
THR and Infection

**Antibiotics** - Meta-analysis

4 trials comparing regimens of different duration
Inconclusive, individually and pooled

24 hour course widely favored

? Single dose enough for slowly eliminated drugs
THR and Infection

**Antibiotics** - Meta-analysis

Parenteral or in cement?

Conflicting results
THR and Infection

**Antibiotic loaded cement**

*No good evidence* for using this as well in primary arthroplasty

Release of antibiotic is neither continuous nor complete

Ave 78% remains in cement

Strength

? Resistance

If used, record clearly in notes

Further release at revision when cement broken
THR and Infection

Post-operative measures

Prophylaxis against haematogenous spread?

Urinary instrumentation.

RCS/Dentists Guidelines.
THR and Infection

Diagnosis

Infected?
Organism?
THR and Infection

Classification

Coventry Orth Clin North Am 1975 (6) : 991 - 1003

I  Acute fulminating infections < 3/12
II  Delayed (months), more indolent, often persistent pain
III  Haematogenous spread
## Classification

Tsukayamo D, Estrada R and Gustilo R

Infection after total hip arthroplasty

*JBJS 1996 78-A (4):512 - 523*

### Table 1. Classification of infected total joint replacements.

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive intraoperative culture</td>
<td>Two or more intraoperative specimens positive for the same organism.</td>
</tr>
<tr>
<td>Early postoperative infection</td>
<td>Apparent within 1 month of surgery. Presenting &gt; 1 month after surgery,</td>
</tr>
<tr>
<td></td>
<td>with an insidious clinical onset</td>
</tr>
<tr>
<td>Acute iatrogenic infection</td>
<td>Acute onset of clinical symptoms in a previously well-functioning joint</td>
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</table>

*NOTE: Data are from [6].*
THR and Infection

Diagnosis

History
Pain post-operatively, wound problems

Examination
Sinus, stick

Investigations
WCC, ESR, CRP
Lysis on Xray

Difficult to distinguish from aseptic loosening
THR and Infection

**Diagnosis**

**Early**
Persistent discharge ? Haematoma / Infection EXLPORE

**Late**
**Blood Tests and Imaging** (Sensitivity and Specificity)
THR and Infection

Investigations

ESR and CRP

Elevated in 70% infected cases with overt infection
THR and Infection

ESR and CRP
Periprosthetic low grade hip infections
Sanzen L. and Sundberg M Acta Orth Scand 1997; 68(5): 461-465

Slight increases over pre-op levels indicative of infection

ESR more sensitive

Only one patient (of 23) had normal values for both markers

Recommend pre-op measurement of ESR and CRP
THR and Infection

**CRP**

White et al

JBJS-Br 1998 80-B (5) 909-11

CRP level after total hip and total knee replacement

Trend more important than absolute values

The CRP level after THR and TKR. Each box indicates the median, 25 and 75 percentiles and minimum and maximum values for each set of data.
THR and Infection

**Investigations**

Radiographs

Sequential films useful

- Radiolucent lines / focal osteolysis / periosteal reaction

  Absence of above does not rule out infection

Lynch et al 1987

ALL cases retrospectively diagnosed on X-ray within 1 yr
## THR and Infection

### Nuclear Medicine

**Levitsky et al**

Evaluation of the painful prosthetic joint

*J Arthroplasty; 6 (3):237-244. 1991*

<table>
<thead>
<tr>
<th>Test</th>
<th>Sens</th>
<th>Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESR</td>
<td>60%</td>
<td>65%</td>
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<tr>
<td>3pbs</td>
<td>33%</td>
<td>86%</td>
</tr>
<tr>
<td>Aspiration</td>
<td>67%</td>
<td>96%</td>
</tr>
</tbody>
</table>
THR and Infection

**Nuclear Medicine**

Gallium
- High specificity but low sensitivity

Indium 111 scintigraphy
- High sensitivity but low specificity

Immunoglobulin labeling
- As yet unclear

Tc99 and Indium 111 100% sensitive, 97% specific
“Availability of an investigation is not an indication for its performance.”

Wroblewski 1990
THR and Infection

Investigations

Unclear Medicine

Just stalling
THR and Infection

Investigations

“Ultimately only the identification of an organism or a biopsy confirming the presence of acute inflammatory cells can confirm the diagnosis”

Gillespie 1997
THR and Infection

Aspiration
Levitsky et al Evaluation of the painful prosthetic joint
J Arthroplasty; 6 (3):237-244. 1991

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<tr>
<th></th>
<th>Sens</th>
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<tr>
<td>Aspiration</td>
<td>67%</td>
<td>96%</td>
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</tbody>
</table>

(Culture from sinus swab useless
Mackowiak et al JAMA 1978
Diagnostic value of sinus-tract cultures in chronic osteomyelitis)
THR and Infection

Investigations

Intra op culture / frozen section

<table>
<thead>
<tr>
<th></th>
<th>Sens</th>
<th>Spec</th>
</tr>
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<tbody>
<tr>
<td>Frozen Section</td>
<td>82%</td>
<td>93%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>96%</td>
</tr>
<tr>
<td>(Aspiration)</td>
<td>67%</td>
<td>96%</td>
</tr>
</tbody>
</table>

Pace et al J Arthroplasty 1997,12 (1); 64-69
Feldman et al JBJS 77-A (Dec 95) 1807-13
 THR and Infection

Investigations
Advances in the diagnosis of infection in prosthetic joint implants
Mariani BD and Tuan RS.

Polymerase Chain Reaction (PCR)
Culture assays gold standard for pathogen detection.

Enzymatic amplification of pathogen genetic material
Results within 2 hours
THR and Infection

Polymerase Chain Reaction (PCR)

Fifty revision arthroplasty cases with positive PCR
88% pre / intra-operative diagnosis (2 stage revision.)
12% no evidence of infection (one stage revision.)

Of these 75% positive cultures or re-presented with infection
Others well at 1-2 year follow up.

Improve diagnosis and aid decision making
THR and Infection

Treatment
THR and Infection

Treatment Aims

Eradication of infection

Restoration of function
THR and Infection

Treatment options

Debridement + Antibiotics
Antibiotic suppression
Excision arthroplasty
Amputation
Arthrodesis
Exchange arthroplasty
THR and Infection

Debridement

Early infection

Thorough debridement with retention of a well fixed prosthesis and antibiotic treatment
THR and Infection

**Implant retention**

Observational studies: implant retention fails in 32 - 82 %.

Recent studies:
- staphylococcal infections
- combination therapy including rifampicin
- 62% success
THR and Infection

**Implant retention**

Role of Rifampicin for Treatment of Orthopaedic Implant Related Staphylococcal Infections.

THR and Infection

Implant retention

Thirty-three patients proven early (< 3/52) infection and stable implants
Surgical debridement (in 29/33 cases)

2/52        I.V. flucloxacillin       oral rifampicin or placebo
3/12        ciprofloxacin           rifampicin or placebo

2 year follow up.
THR and Infection

**Implant retention**

Cure defined as lack of clinical or radiological signs of infection and a CRP below 5 mg/L.

**Rifampicin  100%**

| Placebo 58% |

Independent safety advisor stopped the trial

Where the implant is stable and the infection early, initial debridement *without device removal* followed by rifampicin combinations for staphylococcal implant infections.
THR and Infection

**Excision Arthroplasty**
Effective in eradicating sepsis
Can provide reasonable function

Walking aid
Shoe raise
Increasing energy expenditure

Grauer et al. Resection arthroplasty of the hip JBJS 71-A: 669-678
THR and Infection

**Exchange Arthroplasty**

1 stage

No RCT comparing techniques

2 stage

Radical debridement + appropriate antibiotics
THR and Infection

1 stage
Quicker return to function
Cheaper

Sensitivity of organism must be known
Healthy host with good bone stock

Contraindications
Bone loss requiring allograft
Cementless prosthesis (Ab cement)
THR and Infection

1. History, Examination, Serial radiographs, Plasma viscosity / C.R.P.

2. Probable infection: Biopsy
   - +ve: Organism known?
     - yes: Criteria satisfied for 1 stage revision
     - no: 2 stage revision
   - -ve: Not infected

3. Possibly infected: Organism known?
   - yes: 1 stage revision
     - +ve: Antibiotic loaded cement
       - +ve: 2 weeks iv antibiotics
       - -ve: 3 months oral antibiotics
     - -ve: 2nd stage
   - no: 1 stage revision (leaves)

4. Not infected: 1 stage revision
THR and Infection

2 stage

Traditionally resection and debridement then parenteral antibiotics. Reimplantation often one year later.

Controversies:
- Antibiotic delivery (cement / IV / oral)
- Antibiotic duration
- Cementless prostheses
- Allograft
THR and Infection

Cement spacers

Traction favored in past

Cement: beads (surface area) / spacer

Spacer concept from knee surgery
THR and Infection

Spacers

A cement spacer for two-stage revision of infected implants of the hip joint

Hand molded spacer.

50% failed due to fracture or dislocation
THR and Infection

Spacers

PROSTALAC
THR and Infection

**Spacers**

**PROSTALAC** *(PROSThesis of Antibiotic Loaded Acrylic Cement)*

Younger et al The outcome of two-stage arthroplasty using a custom made interval spacer to treat the infected hip
J Arthroplasty 1997; 12(6) 615 - 623

94% eradication of infection at 4 years.
Second stage at 6-8/52
Lower overall health costs
THR and Infection

RESULTS
THR and Infection

Retain or 2 stage

Tsukayamo D, Estrada R and Gustilo R
Infection after total hip arthroplasty
JBJS 1996 78-A (4):512 - 523

<table>
<thead>
<tr>
<th>Group</th>
<th>Good Results</th>
<th>Treatment</th>
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<tbody>
<tr>
<td>Intra-op cultures</td>
<td>28/31 (90%)</td>
<td>(Revision)Ab IV</td>
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<tr>
<td>Early</td>
<td>25/35 (71%)</td>
<td>Debride, Retain, Ab</td>
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<tr>
<td>Late</td>
<td>29/34 (85%)</td>
<td>2 Stage. Beads</td>
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<tr>
<td>Haematogenous</td>
<td>3/6 (50%)</td>
<td>Debride, Retain, Ab</td>
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</table>
THR and Infection

1 stage


77% success in 583 patients

(90% after further procedures)
THR and Infection

1 stage

Raut, Siney and Wroblewski
One-stage revision of total hip arthroplasty for infection
Clin Orth 1995: (321) : 202-207

183 procedures
84.2% success at 7 years 9 months
## THR and Infection

### TABLE 1

<table>
<thead>
<tr>
<th>Method of Reconstruction with Use of Antibiotics</th>
<th>Year</th>
<th>No. of Hips</th>
<th>No. of Successful Results</th>
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<tr>
<td><strong>Direct-exchange arthroplasty</strong></td>
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<td>Anti-Poikka et al.</td>
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<td>Buchholz et al.</td>
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<td>583</td>
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<td>Carlsson et al.</td>
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<td>102</td>
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<td>1189</td>
<td>976 (82%)</td>
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<td><strong>Two-stage exchange arthroplasty</strong></td>
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<td>Hope et al.</td>
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<td>Hovclius and Josefsson</td>
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<td>Lieberman et al.</td>
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<td>Murray</td>
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<tr>
<td>Sanzén et al.</td>
<td>1988</td>
<td>56</td>
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<tr>
<td></td>
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<td>423</td>
<td>385 (91%)</td>
</tr>
</tbody>
</table>
THR and Infection

**2 stage** - Shorter interval

Colyer and Copello. Surgical treatment of the infected hip implant. Two stage revision with a one month interval. Clin Orth 1994 (298) 75-79

84% success

Accurate microbiology with minimum morbidity from delay
THR and Infection

Overall Results

1 1 stage

2 1 stage, Ab cement

3&4 2 stage

5 2 stage, Ab cement
THR and Infection

Conclusions - Diagnosis

High index of suspicion

? Pre-op ESR / CRP
THR and Infection

Conclusions - Diagnosis

Nuclear medicine - unhelpful

Molecular Medicine may soon aid diagnosis
THR and Infection

Conclusions - Treatment

**Early:** Debridement / Rifampicin + Ciprofloxacin
allows implant retention (staph)

**Later:**
One stage indications limited
? trials only
Two-stage ? PROSTALAC
THR and Infection

Prevention