Management of Surgical Site Infection (Orthopaedics Prospective)

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Areas exploring

- Terminology and Definition
- Epidemiology
  - How to apply?
- Approach
  - Establish Diagnosis
  - Local strategies
  - Specific points for infection of Total Joint Arthroplasty
  - Literatures
Definitions of SSI (CDC)

- The CDC definition describes three levels of SSI:
  - **Superficial incisional** *(the skin and subcutaneous tissue)*
    - Indicated by localized signs such as redness, pain, heat or swelling at the site of the incision or by the drainage of pus.
  - **Deep incisional** *(fascial and muscle layers)*
    - The presence of pus or an abscess, fever with tenderness of the wound, or a separation of the edges of the incision exposing the deeper tissues.
  - **Organ or space infection**, which involves any part of the anatomy other than the incision that is opened or manipulated during the surgical procedure, for example joint or peritoneum.
    - The drainage of pus or the formation of an abscess detected by histopathological or radiological examination or during re-operation.

Acute infection: within 4 weeks
Chronic infection: beyond 4 weeks
Surveillance of Surgical Site Infections in NHS Hospitals in England

2011/2012
Summary of UK NHS Date on SSI
4/07-3/12
496373 in 235 hospitals
No. of SSI : 4771 → 0.96%
## Breakdown (%)

<table>
<thead>
<tr>
<th>Orthopaedic Surgeries</th>
<th>General Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Prothesis</td>
<td>Cholecystectomy</td>
</tr>
<tr>
<td>0.38</td>
<td>1.3</td>
</tr>
<tr>
<td>Knee Prosthesis</td>
<td>Gastric</td>
</tr>
<tr>
<td>0.22</td>
<td>3.0</td>
</tr>
<tr>
<td>Reduction of long bone fracture</td>
<td>Small bowel</td>
</tr>
<tr>
<td>0.73</td>
<td>6.3</td>
</tr>
<tr>
<td>Repair of neck of femur</td>
<td>Bile duct, liver, pancreatic surgery</td>
</tr>
<tr>
<td>1.2</td>
<td>6.2</td>
</tr>
<tr>
<td>Spine</td>
<td>Large bowel</td>
</tr>
<tr>
<td>0.5</td>
<td>8.8</td>
</tr>
<tr>
<td>Limb Amputation</td>
<td>Breast</td>
</tr>
<tr>
<td>3.6</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Median Time of Occurrence of SSI

- 10-15 days for Hip and Knee Replacement, Lower limb fracture including lower limb amputation
- Small and large bowel surgery, Hepatobiliary Surgery around 8 days
- Cardiac Surgery 10-11 days
Proportion between Superficial and Deep SSI

- Comparable between Superficial and Deep Incisional
- Slightly more than half for patient readmitted for infection management (Implied Chronicity)
Figure 7: Overall distribution of organisms reported as causing SSIs (inpatient and readmission), all surgical categories, NHS hospitals, England, 2011/2012.

- **Enterobacteriaceae**: 28.5%
- **S. aureus**: 4.4%
- **Coagulase negative staphylococci**: 13.8%
- **Enterococcus spp**: 15.9%
- **Pseudomonas spp**: 8.3%
- **Other bacteria**: 7.0%
- **Anaerobes**: 6.2%
- **Streptococcus spp**: 6.1%
- **Fungi**: 4.0%
- **Acinetobacter spp**: 1.5%
- **Other bacteria**: 0.4%

**NB**: ‘Other bacteria’ - mostly comprising ‘other Gram-positive organisms’, ‘unspecified diphtheroids’ and other Gram-negative bacteria.
Figure 9: Organisms reported as causing SSI* in orthopaedic categories by detection method, NHS hospitals, England, 2011/12

NB: ‘Other bacteria’ in orthopaedic categories – mostly comprising isolates reported as ‘unspecified diphtheroids’, Corynebacterium spp. and ‘other Gram-positive organisms’.
Figure 8: Distribution of organisms reported as causing SSI* by surgical category, NHS hospitals, England, 2011/2012

*Isolates from inpatient and readmission SSI; NB: “Other bacteria” - mostly comprising ‘other Gram-positive organisms’, ‘unspecified diphtheroids’ and ‘other Gram-negative bacteria’.
Risk factors

Patients’
- Advanced age >65
- BMI >25kg/m²
- ASA Score >3 (American Society of Anesthesiologists)
- Chronic Malnutrition
  - Albumin <35g/L
- DM
- Smoking
- Immunosuppression
  - RT, Steroid
- Infection at remote site
- Prolong hospital bed rest

Surgeons’ and Assistants’
- Hygiene
- Gowning and gloving
- Surgery on contaminated/dirty wounds
- Previous surgery(ies)
  - Choice of surgical incision*
- Prolong surgery >5hours
- Instrumentation
- Soft tissue handling
  - Hematoma collection
  - Tissue necrosis
- High volume of personnel movement
- Emergency operation

Implications of Epidemiology Data of SSI

- “know about your enemy”
- Set-up of Guidelines of preventive measures
- Correct choice: Surgery vs Conservative Treatment
- Correct patient
  - Physical fitness, co-morbidity status, nutrition....
  - Will he be able to enjoy the recovery?
- Correct choice of antibiotic prophylactics
Prevention is always better than Cure
Detection for SSI

Be alert for patient with potential risks

- Fever
  - Common to have Day 1 fever due to atelectasis of the lung
  - Uncommon to a sudden spike few days after operation or an increasing trend
- Increasing local wound pain at rest
- Sudden increasing in staining of dressing after a week

Investigations

- Blood tests
  - WBC, CRP, ESR
- Sepsis work-up: Possible Sources
  - Documentation for physical signs of Upper Respiratory Tract, Urinary Tract, lower limb DVT, flare up of gouty arthritis
- Imaging
  - X ray
  - CT Scan
Interpretation of Blood Tests

- Raised WBC D/C, CRP and ESR
- The sensitivity of the C-reactive protein and erythrocyte sedimentation rate for infection was .96 and .82 respectively.
- Most importantly, when both the C-reactive protein and erythrocyte sedimentation rate were negative, the probability of infection was zero. (C Duncan *J Bone Joint Surg Am.* 1999; 81(5):672-682.)
Serial Radiographs

- Loosening of Implant
  - Radiolucency around implant
  - Implant-bone interface
  - Cement-Implant interface
  - Cement-bone interface
- Early Subsidence of implant
If Surgical Site Infection is detected **prompt enough, correct choice and dose of antibiotics** can still tackle the problem without subjecting the patient to surgical exploration.

Superficial Incisional type will have a better chance with conservative treatment.
Conditions where chance of conservative treatment is glimpse

- Deep infection
  - Implant-in-situ
    - Posterior Spinal Instrumentation and bone graft
    - Hip and knee prosthesis
  - Spinal infection with CSF leakage
    - Severe meningitis if treatment is not aggressive
- Persistent drainage from wound with increase in pain symptom (symptoms masked by DM polyneuropathy)
- An ischemic wound edge of stump
Technical Aspect

Surgical management of Wound
Steps of Surgery- w.r.t. Orthopaedic Surgeries

- Exploration of wound
  - Debridement of devitalized tissue including wound edge
  - For suspected case or for second exploration
    - Frozen section of tissue for deep prosthesis infection
    - Intra-operative confirmation of more than 10 leucocytes per high-power field
  - Pulse Irrigation with NS
    - Decrease bacterial load
  - Irrigation with antiseptics (Aqueous Hibitane) or antibiotic solution
    - Amikacin in Hartmann
  - Use of antibiotic cement
  - Wound packing or Closed under drainage
Specific Conditions

For Hip and Knee Prosthesis

- Debridement and Irrigation
- Considering removal of Polyethylene Liner and to revised second stage
- For chronic infection, whole prosthesis may have to be taken out followed by putting in antibiotic spacer
- Repeated debridement till optimal condition attained
- Second stage revision

For infection over internal fixation implant

- Keep implant by all mean to maintain stability of fracture of limbs or spinal column
- Otherwise septic non-union will occur
Use of Antibiotic Impregnated Cement - concepts – Total Joint Arthroplasty

- Creation of a very high concentration of antibiotics over deep infected area to achieve bacteriocidal effect
- Act as a Spacer to maintain joint space for subsequent reimplantation
- Gentamicin-Beads
- Self prepared antibiotics cement (high viscosity and quick dough time )
  - With Gentamycin, Tobramycin or vancomycin
  - Palacos R or Palacos R+G (0.5gm Gentamycin)
Prostalac System

- Prostalac hip system
  - Self moulding cement (Tobramycin, Vancomycin) on Cobalt Chrome temporary fem stem and cement acetabular cup

Younger et al, 61 infected total hips were treated with staged revision using the PROSTALAC spacer. At final follow-up, 94% of infections were eradicated. J Arthroplasty. 1997; 12(6):615-623.
Spacer G, K, S

- Gentamicin-impregnated Cemex® PMMA bone cement molded onto a stainless steel reinforcing core.
- Two Stage Mx of Infected THR
- Maintains joint space and allows limited mobility
- Enables patient ambulation with partial weight-bearing
- Provides for predictable, consistent antibiotic release locally
- To place for not more than 180 days
Spacer G
Intramedullary Rod and Cement Static Spacer Construct in Chronically Infected Total Knee Arthroplasty – Example of Static Spacer
Suhel Kotwal et al Am J Orthop (Belle Mead NJ) 1999 Mar;28(3):161-5. 2
University of Chicago Hospitals1; Louis A. Weiss Memorial Hospital2, Chicago,

Average time the patients were considered to be clinically infected was 15.5 months

67.2% had confirmed deep bacterial infection by aspiration; In 32.8% a microorganism could not be identified.

Static spacer construct that uses a tibiofemoral, intramedullary rod and antibiotic-laden cement.
Results
Suhel Kotwal et al

- 37 patients (63.8%) underwent reimplantation after negative joint fluid culture and intra-operative confirmation of less than 5 leucocytes per high-power field on frozen section.
- The mean interim period between resection, antibiotic spacer, and re-implantation was 19.4 weeks (range, 9-45 weeks).
- Mean Fu 29.4 months
- 6 re-infection
- A quadriceps snip in two patients (5.4%) and a local rotation medial gastrocnemius flap and split-thickness skin graft was successfully utilized for wound closure for 8 patients (13.8%) during resection and 6 patients (16.2%) during re-implantation.
Wound Coverage

- Direct closure should be the target
- PTSG/Split skin graft
  - For area not facing direct pressure
- Rotation, pedicle, free flap (bring in blood supply)
- Pedicle muscle flap to fill in dead space
  - Soleus flap
- Implant should be covered with tissue resistant to local pressure (flap coverage)
- V.A.C Dressing
Muscle Flap Salvage of Spine Wounds With Soft Tissue Defects or Infection

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Conclusions

- Correct Choice of Surgery on a correct patient
- Prevention by all means
- High index of suspicion of Surgical Site Infection
- Appropriate choice of investigations to confirm the dx
- Local and Systemic Optimization
- Prompt as well as aggressive approach
- Stable implant will be kept
- Debridement and Irrigation for early infection of TJR
- Stage Revision for Chronic Infection
- Wound closure can be achieved with multi-modality