Surgical site infections: How to prevent them

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Surgical site infections

- 17% of all hospital acquired infections
- The incidence varies for each operative procedure, each surgeon and each hospital
- Infections present several days post-operatively
- Optimization of peri-operative factors which are controlled by Anesthesiologists

Perioperative Infection

- Sick, vulnerable and healthy
- Source: Nosocomial, Community acquired.
- Drug resistance: multiple drug resistance
- Fewer new ABX
Perioperative Infections
- Critical care units
- Operating rooms
- Labor wards
- Emergency care units
- Operating rooms

Reasons: Infection
- Inappropriate selection of Prophylactic
- Pre-op abx
- Inadequate barrier hygiene techniques
- Interruption of antibiotic regimen
- Cross contamination between health care personnel and patient.

Factors affecting Surgical site infections
- 1.Hygiene
- 2.Hypothermia
- 3.Hyperoxia
- 4.Blood transfusions
- 5.Peri-operative Fluid Management
- 6.Hyperglycemia
- 7.Antimicrobial Prophylaxis
- 8.Timing and choice of antibiotic
- 9.Optimiztion of Peri-operative Environment
**Peri-operative factors for SSI**

- **Hypothermia**: The incidence of infection 5.8% in the normothermic group and 18.8% in the hypothermic group.
- **Intra-op vasoconstriction** was present in 74% of the hypothermic patients and only 6% of the normothermic patients.
- **S.C. oxygen tension** 40-50 mmHg had an infection rate of 46%.
- **Bacterial killing by neutrophils** is reduced in the face of hypothermia.

**Hypothermia**

- Continued heat loss in the O.R. are radiation and convection.
- Forced air warming and warming fluids.
- Actively pre-warming prior to induction of General anesthesia attenuate the vasoconstriction.

**Hyperoxia**

- Supplemental oxygen during the peri-operative period would lead to higher oxygen tensions in the wound and decrease the incidence of SSIs.
- Significant reduction of infection in 0.8 Fio2 compared to Fio2 = 0.3.
- Continuation of higher conc of oxygen for 2-6 hours post-op also improves wound healing.
**Hyperglycemia**

- Stringent Glucose control reduces SSI in variety of situations
- There is Correlation between hyperglycemia and the risk of SSI, particularly in cardiac surgical patients.
- Neutrophil phagocytic function better preserved in Euglycemic patients

**Blood Transfusion: Risk of Infection**

- Transfusion of blood products increases the risk of SSI
- SSIs with allogenic transfusions higher than autologous
- Immunomodulatory effects of transfusion reflects leukocyte donor effect.
- Leukocyte depleted blood may have less SSI

**Important factors to control infection**

- Clipping hair : Prior to surgery
- Antibiotics : Timing of Antibiotics
- Temperature: Maintaining Normothermia
- Sugar : Normoglycemia
Preoperative Hair Removal

- There is a scarcity of data to support the use of surgical site preoperative shaving
- Clippers have been associated with a reduction in postoperative infection rates
- A meta-analysis by the Cochrane group showed that the relative risk of a surgical site infection following hair removal with a razor was significantly higher than that following hair removal with clippers

Antimicrobial Prophylaxis

- Appropriate Antibiotic
- Timing of Antibiotic, 1 Hr before incision
- Prophylaxis should end within 24 Hrs
- Vancomycin for MRSA patients
- Clindamycin and Vancomycin for Penicillin allergic patients

Infection Control Guidelines

- Universal Precautions
  - Hand washing before and after pt. contact.
  - Use of gloves when in contact with blood or any pt. body surface.
  - Caution when handling needles.
  - Specific Institutional Protocols

<table>
<thead>
<tr>
<th>Disease</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis A</td>
<td>Universal precautions, none</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>Universal precautions, vaccination</td>
</tr>
<tr>
<td>Hepatitis C</td>
<td>Universal precautions, currently no vaccination available</td>
</tr>
<tr>
<td>HIV</td>
<td>Universal precautions, post-exposure prophylaxis</td>
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<tr>
<td>Tuberculosis</td>
<td>Universal precautions, annual PPD</td>
</tr>
<tr>
<td>Influenza</td>
<td>Universal precautions, annual vaccination</td>
</tr>
</tbody>
</table>
Surgical Site Infections

- Patient’s pre-existing factors that relate to SSI:
  - Diabetes
  - Obesity
  - Nicotine use
  - Malnutrition
  - Immunosuppressive medication use

- Physician’s control of factors that relate to SSI:
  - Hypothermia
  - Hyperglycemia
  - Hair removal
  - Perioperative antibiotics; administering and documenting within one hour of surgical procedure

Postoperative Ventilator-Associated Pneumonia

- Patient’s high risk for VAP:
  - History of smoking
  - COPD
  - Extended mechanical ventilation
  - Surgical trauma
  - Abnormal blood urea nitrogen levels

- Physician measures to reduce VAP:
  - Hand washing; use of alcohol-based foams or gels
  - Oral care assessment; brushing, chlorhexidine gluconate 0.12%, and frequent suctioning
  - Head of bed 30-45 degrees
  - Decontamination of GI tract; systemic antibiotics and nonabsorbable antibiotics
  - Rapid weaning of patients from ventilators
Hand Washing

Intravascular Catheter-Related Infections

<table>
<thead>
<tr>
<th>Catheter Type</th>
<th>Entry site</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral venous catheters</td>
<td>Usually inserted in veins of forearm or hand.</td>
<td>Rarely associated with bloodstream infection; phlebitis with prolonged use.</td>
</tr>
<tr>
<td>Peripheral arterial catheters</td>
<td>Usually inserted in radial artery; can be placed in femoral, axillary, brachial, or dorsalis pedis.</td>
<td>Rarely associated with bloodstream infection.</td>
</tr>
<tr>
<td>Central venous catheters</td>
<td>Inserted in central veins (subclavian, internal jugular, or femoral)</td>
<td>Account for the majority of catheter-related bloodstream infections.</td>
</tr>
<tr>
<td>Pulmonary artery catheters</td>
<td>Inserted through a catheter introduced in a central vein</td>
<td>Similar rates of bloodstream infection as CVC; subclavian site preferred to reduce infection risk.</td>
</tr>
</tbody>
</table>
Intravascular Catheter-Related Infections

- Strategies for Prevention
  - Teflon or polyurethane catheters
  - Hand hygiene; aseptic technique (peripheral catheters).
  - Sterile technique (central catheters).
  - Skin antisepsis
  - Transparent, semipermeable polyurethane dressing regimens; Tegaderm
  - Sutureless catheter securement devices
  - In-line filters

- Antimicrobial/Antiseptic Impregnated Catheters and Cuffs
- Systemic Antibiotic prophylaxis
- Antibiotic/Antiseptic Ointments
- Antibiotic Lock prophylaxis
- Anticoagulants
- Replacement of Catheters (related to type of catheter placed)

Proven Benefits of Antimicrobial Prophylaxis

- Patzakis and Wilkins --> preoperative administration of appropriate antibiotics is the most important factor in determining wound infection rates associated with open fractures
- Cochrane Database of Systemic Reviews also endorses the use of prophylactic antibiotics in treating open fractures
Choice of Antibiotic in Open Wound Fractures

- Most common organisms in deep wound infections -- Staphylococcus aureus and coagulase-negative staphylococci such as Staphylococcus epidermidis
- First line -- cefazolin or cefuroxime for hip or knee arthroplasty, fixation of closed fractures, and most elective orthopedic procedures
- Vancomycin or clindamycin may be used for patients with an allergy or adverse reaction to beta-lactam antibiotics

Choice of Antibiotic in Open Wound Fractures

- According to recommendations by the Surgical Infection Society (SIS) and the Eastern Association for the Surgery of Trauma (EAST) for all type-III and perhaps some type-II fractures add GN coverage secondary to increased contamination and higher-energy mechanism associated with these fractures
- Add penicillin to the prophylactic regimen for fractures at risk for clostridial contamination

Recommendations by the American Academy of Orthopedic Surgeons for Repeat Doses of Antibiotics

- Antibiotics should be given within sixty minutes prior to incision

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Frequency of Administration</th>
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<tbody>
<tr>
<td>Cefazolin</td>
<td>Every 2-5 hours</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>Every 3-4 hours</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>Every 3-6 hours</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>Every 6-12 hours</td>
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</tbody>
</table>
Recommendations for Perioperative Administration of Antibiotics in Orthopedics

<table>
<thead>
<tr>
<th>Grade of Recommendation</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Broad-spectrum antibiotics should be administered within one hour of incision time and continued up to 24 hours postoperatively. Patients with an open fracture should receive antibiotics urgently, and administration should be continued for at least 24 hours postoperatively. A first-generation cephalosporin should be used for all open fractures when not otherwise contraindicated.</td>
</tr>
<tr>
<td>B</td>
<td>Vancomycin appears to be equivalent to a first generation cephalosporin in the prevention of perioperative infection when there is a history of methicillin-resistant Staphylococcus aureus infection.</td>
</tr>
<tr>
<td>C</td>
<td>Local antibiotics may help reduce the rate of infection and osteomyelitis in association with open fractures. Vancomycin may be used as antibiotic prophylaxis in patients with a beta-lactam allergy.</td>
</tr>
<tr>
<td>I</td>
<td>Aminoglycosides may decrease infection rates with Gustilo and Anderson type II and III open fractures.</td>
</tr>
</tbody>
</table>

Duration of Antibiotic Coverage in Orthopedics

- A single dose of antibiotics may be adequate for prophylaxis against perioperative infection.
- SIS and EAST groups both recommended the use of prophylactic antibiotics for 24 hours postoperatively for patients with a type-I open fracture and for 48 to 72 hours for those with a type-III open fracture.

Recommendations for Patient Preparation and Surgical Scrubs

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<tr>
<td>A</td>
<td>Compared with povidone-iodine, chlorhexidine surgical scrubs provide a prolonged reduction in skin contamination with less toxicity and irritation. Although surgical hand rubs are not equivalent to traditional surgical scrubs, chlorhexidine surgical hand rubs provide far better reduction of bacterial contamination. Surgeons comply with hand-hub protocols better than they comply with surgical scrub protocols. A patient’s temperature, oxygenation, and serum blood glucose level should be optimized in the perioperative period.</td>
</tr>
<tr>
<td>B</td>
<td>The use of iodophor-impregnated surgical drapes decreases skin contamination but does not appear to reduce infection rates. The use of Novocain in the operating room is associated with decreased rates of wound infections and wound contamination. Iodophor prophylaxis should be optimized, and if necessary, performed with clippers or depilatory products.</td>
</tr>
</tbody>
</table>
**ASA Recommendations for Infection Control**

- Prevention of Nosocomial Infections
  1. Disinfection of Equipment
  2. Preventing Contamination of Medications
  3. Prevention of Infection During Insertion and Maintenance of Central Venous Catheters
  4. Protection of the Immunosuppressed Patient
  5. Prevention of Transmission of Tuberculosis and the Anesthesiologist

**Prevention of Occupational Transmission of Infection to Anesthesiologists**

1. Standard Precautions
   a. Handwashing
   b. Use of Barriers
   c. Prevention of Accidental Needlesticks
   d. Treatment of Blood Exposures
   e. Emergency Ventilation Devices
   f. Personnel With Cutaneous Lesions
2. Hepatitis B Vaccine
3. Smoke Evacuation During the Use of Lasers or Electrosurgical Units

**Prevention**

- CDC
- OSHA
- JCAHO
- ASA
- Appropriate protocols and Guidelines
- VRE, C.DIFF
Conclusion.

- Education of HC personnel
- Appropriate use of ABX
- Cleaning procedure for devices and keyboards
- Periodic auditing of HC personnel regarding vaccination.

Conclusion

- SSI remain an important cause of patient morbidity and mortality.
- There is strong evidence that normoglycemia is an appropriate goal.
- Hypothermia is harmful to many surgical patients.
- Optimization of perioperative environment by anesthesiologist.

References

- Fletcher, Nicholas, Sofianos, D’Mitr; Berkes, Marschall; Brantling, Obrinskey, William T; Prevention of Perioperative Infection
- Breidic, T.A. Surgical Care Improvement Project and the Perioperative Nurse’s Role. AORN Journal. July 2007 Vol. 86/ No. 1
- Infection Control Guidelines For The Medical Staff. University of Oklahoma Medical Center Policy.