Introduction

- Surgical infections may arise in the surgical wound itself or in other systems in the patient.
- They can be initiated not only by “damage” to the host but also by changes in the host’s physiologic state.

Two main types

1. Community-Acquired: Are active process that were initiated before the patient presented for treatment
2. Hospital-Acquired: All infections that occur after surgical procedures

Community-Acquired

- Skin/soft tissue
  - Cellulitis: Group A strep
  - Abscess/furuncle: Staph aureus
  - Necrotizing: Mixed
  - Hiradenitis suppurativa: Staph aureus
  - Lymphangitis: Staph aureus
  - Gangrene: synergistic
- Tetanus
- Hand infections
- Foot infections
- Biliary tract infections
- Peritonitis
- Viral infections

Hospital-Acquired

- SSI (Wound infection)
- Pulmonary
- Urinary Tract
- Intra-abdominal
- Empyema
- Foreign-body associated
- Fungal infection
- Multiple organ failure

What is a Surgical Site Infection?

- SSI’s can be defined as an infection that is present up to 30 days after a surgical procedure if no implants are placed, and up to one year if an implantable device was placed in the patient
- The majority of SSIs will occur during the first 2-3 weeks after surgery
- 38% of all nosocomial (hospital acquired) infections in surgical patients are SSI
- 2 to 5% of operated patients will develop a SSI

Some definitions

- Colonization: presence of bacteria in a wound with no signs or symptoms of systemic inflammation. usually bacterial count less than 10*5cfu/ml
- Contamination:
  - Transient exposure of a wound to bacteria.
  - Varying concentration of bacteria possible.
  - Time of exposure less than 6 hours.
  - SSI prophylaxis is best strategy.
- Infection:
  - Systemic and local signs of inflammation
  - Bacterial count more than 10*5cfu/ml
**Types of Surgical Site Infections**

According to the tissue involved:

1. **Superficial**
2. **Deep incisional**
3. **Organ/space**

A **superficial incisional SSI** must meet 1 of the following criteria:

- Infection occurs within 30 days after the operative procedure and
- involves only skin and subcutaneous tissue of the incision and
- patient has at least one of the following:
  a. purulent drainage from the superficial incision.
  b. organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
  c. at least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat, and superficial incision are deliberately opened by surgeon, and are culture-positive or not cultured. A culture-negative finding does not meet this criterion.
  d. diagnosis of superficial incisional SSI by the surgeon or attending physician.

A **deep incisional SSI** must meet one of the following criteria:

- Infection occurs within 30 days after the operative procedure if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operative procedure and
- involves deep soft tissues (e.g., fascial and muscle layers) of the incision and
- patient has at least one of the following:
  a. purulent drainage from the deep incision but not from the organ/space component of the surgical site
  b. a deep incision spontaneously dehisces or is deliberately opened by a surgeon and is culture-positive or not cultured and the patient has at least one of the following signs or symptoms: fever (>38°C), or localized pain or tenderness. A culture-negative finding does not meet this criterion.
  c. an abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination
  d. diagnosis of a deep incisional SSI by a surgeon or attending physician.

An **organ/space SSI** must meet one of the following criteria:

- Infection occurs within 30 days after the operative procedure if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operative procedure
- infection involves any part of the body, excluding the skin incision, fascia, or muscle layers, that is opened or manipulated during the operative procedure and
- patient has at least one of the following:
  a. purulent drainage from a drain that is placed through a stab wound into the organ/space
  b. organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space
  c. an abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination
  d. diagnosis of an organ/space SSI by a surgeon or attending physician.
Further classifications

- According to the etiology
  - Primary SSI: the wound is the primary site for infection
  - Secondary SSI: infection arise following a complication that is not directly related to the wound
- According to the time
  - Early within 30 days
  - Intermediate 1-3 months
  - Late more than 3 months
- According to Severity
  - Minor SSI: discharge without cellulites or deep tissue destruction
  - Major SSI: pus discharge with tissue breakdown, partial or total dehiscence or systemic illness

**Source of SSI Pathogens**

1. Endogenous flora of the patient
2. Operating theater environment
3. Hospital personnel (doctors/nurses/staff)
4. Seeding of the operative site from distant focus of infection (prosthetic device, implants)

**Pathogenesis of SSI**

- Relationship equation, SSI Risk = \[
\frac{\text{Dose of bacterial contamination} \times \text{Virulence}}{\text{Resistance of host}}
\]

**Risk factors**

1. Surgical factors
   - a. Type of procedure
   - b. Degree of contamination
   - c. Duration of operation
   - d. Urgency of operation
2. Patient-specific factors. Patient-specific factors can be further defined as either
   - **Local**
     - High bacterial load
     - Wound hematoma
     - Necrotic tissue
     - Foreign body
     - Obesity
   - **Systemic**
     - Advanced age
     - Shock
     - Diabetes
     - Malnutrition
     - Alcoholism
     - Steroids, Chemotherapy, Immuno-compromise

**Wound Classification according to the degree of contamination**

<table>
<thead>
<tr>
<th>Wound class</th>
<th>Definition</th>
<th>Example</th>
<th>Infection rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
<td>Nontraumatic, elective surgery. GI tract, respiratory tract, GU tract not entered</td>
<td>Mastectomy Vascular Hernias</td>
<td>2%</td>
</tr>
<tr>
<td>Clean-contaminated</td>
<td>Respiratory, GI, GU tract entered with minimal contamination</td>
<td>Gastrectomy Hysterectomy</td>
<td>≤ 10%</td>
</tr>
<tr>
<td>Contaminated</td>
<td>Open, fresh, traumatic wounds, uncontrolled spillage, minor break in sterile technique</td>
<td>Rupture appy Emergent bowel resect.</td>
<td>20%</td>
</tr>
<tr>
<td>Dirty</td>
<td>Open, traumatic, dirty wounds; traumatic perforation of hollow viscus, frank pus in the field</td>
<td>Intestinal fistula resection</td>
<td>28-70%</td>
</tr>
</tbody>
</table>
Determinants of the infection

- Every surgical site is contaminated by bacteria at the end of the procedure, few become clinically infected.
- Four important determinants lead to either uneventful wound healing or SSI.
  1. Inoculums of the bacteria
  2. Virulence of the bacteria
  3. Effects of microenvironment
  4. Integrity of host defenses (Innate and acquired)

1. Inoculum of the bacteria

- Sources:
  - Air in operation room
  - Instruments
  - Surgeons and staff
  - Patient’s flora. Largest inoculum is from areas that are heavily colonized e.g. bowel, female GUT, diseased biliary tract
- This factor is modifiable

2. Virulence of the bacteria

- The more virulence the bacteria, the greater probability of infection
  - Coagulase positive staph
  - Virulent strain of perfringens and group A streptococci
  - E coli
  - Bacteroids
- This factor cannot easily be controlled by preventive strategies because it is intrinsic to the procedural site and the type of bacteria that already colonize the patient

3. Effects of microenvironment

- The following factors in the microenvironment of the wound predispose to SSI
  - Necrotic tissue
  - Hb at the surgical site
  - FB, drains
  - Dead space with in the surgical site
  - Surgical techniques

4. Integrity of host defenses

- Innate host defense deficiency
- Acquired host defense deficiency
  - Shock and hypoxia
  - Transfusion
  - Chronic illness
  - Hypoalbuminaemia
  - Malnutrition
  - Hypothermia
  - Hyperglycemia
  - Corticosteroids
  - Obesity
  - Nicotine use
  - Chemotherapy
Prevention of SSI

1. Preoperative planning
   - Control preexisting infection of patient
   - Postpone the operation if open skin wound or hand infection of surgeon present
   - Decrease preoperative hospitalization period
   - Shower and scrub the surgical site with antiseptic soap the evening prior to operation
   - Clipping the hair from surgical site before the operation

2. Intra operative technique
   - Skin preparation
   - Caps, masks gowns, surgical gloves
   - Sterilization of the instruments
   - Gentle handling of tissue
   - Good haemostasis
   - Avoid dead space
   - Insert drains through separate stab incision
   - Leave skin and subcutaneous tissue open if dirty
   - Sterile dressing
   - Topical ointments

3. Preventive antibiotic therapy

4. Enhancement of host defense
   - Increase oxygen delivery
   - Optimizing core body temperature
   - Blood glucose control
   - Correct any coexisting condition e.g malnutrition, anemia