Surgical infections & antibiotics

- Important
- Notes (Doctors')
- Notes (students')

431 SURGERY TEAM

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❖ Infection is defined by:

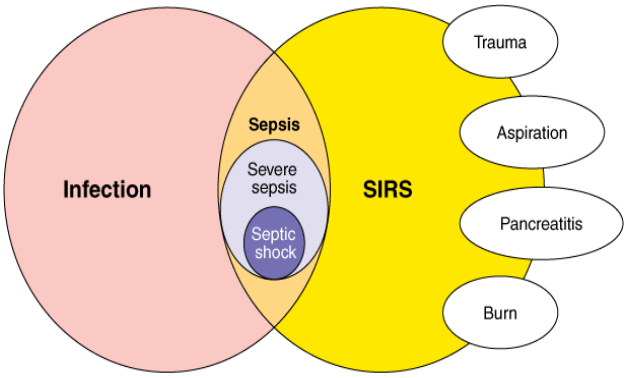
1. Microorganisms in host tissue or the bloodstream
2. Inflammatory response to their presence.

Calor, dolor, rubor, and tumor: Heat, pain, redness, and swelling. The four classical signs of inflammation, originally recorded by the Roman encyclopedist Celsus in the 1st century A.D.

❖ Inflammatory Response:

- **Localized:**
  - Rubor, Calor, Dolor, Tumor, and functio laesa (loss of function).
- **Systemic:**
  - Systemic Inflammatory Response Syndrome (SIRS)
    - **S.I.R.S.**

      Any Two of the Following Criteria:
      1. Temperature: less than 36°C or greater than 38°C.
      2. Heart Rate: greater than 90 beats per minute
      3. Respiratory Rate: greater than 20 breaths per minute (Tachypnea)
      4. WBC: less than 4000 cells/mm³ or greater than 12,000 cells/mm³



    - **Sepsis**

      Definition: SIRS plus evidence of local or systemic infection.
    - **Septic Shock**

      Definition: Sepsis plus end organ hypoprofusion. Mortality of up to 40%

❖ Introduction

- Surgery, trauma, non-trauma local invasion can lead to bacterial insult. Once present, bacteria, initiate the host defense processes. Inflammatory mediators (kinins, histamine, etc.) are released, compliment and plasma proteins are released, PMN's "polymorphonuclear leukocytes" arrive, etc

❖ Risk

- Many established factors have a role in infection.
- These can be either surgical factors or patient-specific factors.
- Patient-specific factors can be further defined as either local or systemic

❖ Surgical Risk Factors

- Type of procedure "will mention it later"
- Degree of contamination
- Duration of operation
- Urgency of operation

❖ SPREAD OF SURGICAL INFECTIONS

- NECROTIZING INFECTION
- ABSCESSES
- PHLEGMONS AND SURPERFICIAL INFECTIONS
- SPREAD OF INFECTIONS VIA THE LYMPHATIC SYSTEM
- SPREAD OF INFECTION VIA BLOODSREAM

❖ COMPLICATIONS OF SURGICAL INFECTION

- Fistulas and sinus tract
- Suppressed wound healing
- Immunosuppression and superinfection
- Bacteremia
- Organ dysfunction Sepsis, and systemic inflammatory response syndrome

A fistula is an abnormal connection between an organ, vessel, or intestine and another structure. Fistulas are usually the result of injury or surgery. It can also result from infection or inflammation.

❖ CLINICAL FINDIINGS AND DIAGNOSIS

- **Physical examination:**
  - Warmth, erythema, induration, tenderness
- **Laboratory findings General findings:**
  - Leukocytosis, acidosis, and signs of disseminated intravascular coagulation
  - Cultures
- **Imaging studies**
- **Source of infection**

❖ TREATMENT

- Incision and drainage "mostly with skin or mass lesions, e.g.: abscess"
- Excision "e.g.: sebaceous cyst, foreign body"
- Antibiotics
- Nutritional support:

  - History,
  - Examination: inspection eg: wasting of temporalis muscle,
  - Blood tests e.g.: - albumin to know the chronic status of the patient
    - Pre-albumin to know the current status of the patient

When can we say this weight loss is significant? If it is More than 10 kg over the past 6 months.

❖ Infections

- **Two main types:**
  - Community-Acquired
  - Hospital-Acquired

❖ Community-Acquired:

♦ Skin/soft tissue Cellulitis:

- Group A strep
- Carbuncles/furuncle: Staph aureus
- Necrotizing: Mixed
- Hiradenitis suppurativa: Staph aureus
- Lymphangitis: Staph aureus

♦ Cellulitis

- **Definition:** Diffuse infection with severe inflammation of dermal and subcutaneous layers of the skin
- **Diagnosis:** Pain, Warmth, Hyperesthesia
- **Treatment:** Antibiotics. "With observation by drawing borders around the affected area to check if there is a response to the treatment or not"
- **Common Pathogens:** Skin Flora (Streptococcus/Staphylococcus)

♦ FURUNCLES AND CARBUNCLES

- Furuncles and carbuncles are cutaneous abscess that begin in skin glands and hair follicles.
- If the pilosebaceous apparatus becomes obstructed at the skin level, the development of a furuncle can be anticipate
- A carbuncle is a deep –seated mass of fistulous tracts between infected hair follicles.
- Furuncles are the most common surgical infections, but carbuncles are rare.

A furuncle is an acute, round, firm, tender, circumscribed, perifollicular staphylococcal pyoderma that usually ends in central suppuration.
A carbuncle is two or more confluent furuncles with separate heads.

Furuncle

Carbuncle

♦ HIDRADENITIS

- Serious skin infection of the axillae or groin Consisting of multiple abscesses of the apocrine sweat glands.
- The condition often becomes chronic
- The cause is unknown but may involve a defect of terminal follicular

♦ TREATMENT

- The classic therapy of furuncle is drainage, not antibiotics.
- Invasive carbuncles must be treated by excision and antibiotics.
- Hidradenitis is usually treated by drainage of the individual abscess and followed by careful hygiene.

Lymphangitis

♦ Lymphangitis

- Lymphangitis arising from cellulitis produces red, warm, tender streaks 3-4 mm wide, spreads from the infection along lymphatic vessels to the regional lymph nodes.

❖ Breast Abscess

- Staphylococcal infection
- Usually post-partum
- MRSA (Methicillin-resistant Staphylococcus aureus) is uncommon.

Treatment: mature Abscess: Incision and drainage. Some surgeons try antibiotic if the abscess is not mature enough or if there is no fluctuation when they do the examination.

❖ Abscess

- **Definition:** Infectious accumulation of purulent material (Neutrophils) in a closed cavity
- **Diagnosis:** **Fluctuation test**: Moveable and compressible
- **Treatment:** Drainage

♦ Peri-rectal abscess

- Results from **infection of the anal crypts** Can be extensive
- Can result in bacteremia
- Treatment: Incision and drainage

❖ Hand Infections:

♦ Paronychia

- An inflammatory reaction involving the folds of the skin surrounding the fingernail.
- It is characterized by acute or chronic purulent, tender, and painful swellings of the tissues around the nail, caused by an abscess of the nail fold.
- The pathogenic yeast causing paronychia is most frequently Candida albicans.
- The causative bacteria are usually Staphylococcus, Pseudomonas aeruginosa, or Streptococcus.
- Treatment: Incision, if not responding antibiotic.

♦ Felon

- Closed-space infections of the fingertip pulp.
- Treatment Incision
- Paronychia can lead to felon
- Both can lead to tenosynovitis

❖ Diabetic foot infection

❖ DIFFUSE NECROTIZING INFECTIONS

- Particular dangerous
- Difficult to diagnose, extremely toxic, spread rapidly, often leading to limb amputation.
- **Pathogenic factors:**
  - Anaerobic
  - Wound Bacterial exotoxins
  - Bacterial synergy
  - Thrombosis of nutrient bridging vessels is a result of necrotizing infection.
- **Classification:**
  - Clostridial "mostly skin and soft tissue"
    - Necrotizing cellulitis
    - Myositis
  - Nonclostridial "mostly deep to the fascia"
    - Necrotizing fasciitis
    - Streptococcal gangrene

♦ Clostridial Infections:

- They are fastidious anaerobes
- On gram-stain they appear as relatively large, gram-positive, rod-shaped bacteria.
- A broad spectrum of disease is caused by clostridia
- **Clinical Findings:**
  - Crepitant abscess or cellulitis
  - Invasion is usually superficial to the deep fascia and may spread very quickly, producing discoloration.
  - Delayed debridement of injured tissue after devascularizing injury is the common setting.
- **Gas Gangrene**:

Clinical Findings:

- Severe pain suggests extension into muscle compartments (myositis).
- The disease progresses rapidly, with loss of blood supply to the infected tissue.
- Profound shock can appear early, rapidly leading to organ dysfunction.
- Air bubbles often visible on plain radiograph Crepitus may be present, but not reliable to differentiation.

♦ Nonclostridial Infections

- Caused by multiple nonclostridial bacterial pathogens.
- Microaerophilic streptococci, staphylococci, aerobic gram-negative bacteria, and anaerobes, especially peptostreptococci and bacteroides.

Clinical Findings:

- Usually begins in a localized area such as a puncture wound, leg ulcer, or surgical wound.
- Externally, hemorrhagic bullae are usually the first sign of skin death
- The skin is anesthetic and crepitus is occasionally present.
- The fascial necrosis is usually wider than the skin appearance indicates.
- At operation, the finding of edematous, dull-gray, and necrotic fascia and subcutaneous tissue confirm the diagnosis.

• Streptococcal gangrene Group A

- Streptococcus is a bacterium frequently found in in the skin and throat.
- Streptococcal gangrene is uncommon The sudden onset of severe pain is the most common presenting symptom, usually in an extremity associated with a wound.
- Fever and other signs of systemic infection are frequently present at the time of presentation.
- Shock and renal dysfunction are usually present within 24 hours.

♦ TREATMENT

- Complete debridement and depress tight fascial compartment. Amputation.
- **Broad-spectrum antibiotic therapy**
- Resuscitative therapy
- Treat diabetes mellitus aggressively
- Hyperbaric oxygenation inhibit bacterial invasion but does not eliminate the focus of infection.

❖ Biliary Tract

- Usually result from obstruction
- Usual suspects: E. coli, Klebsiella, Enterococci

❖ Acute Cholecystitis

❖ GB empyema

❖ Ascending cholangitis

- Diagnosis: ultrasound
- Treatment: antibiotics, relive the obstruction

❖ Peritonitis

- Causes: appendicitis, Acute Cholecystitis, …etc
- Diagnosis: history and examination
- Treatment: treat the underlying cause

❖ Viral

- Hepatitis, HIV/AIDS

❖ Tetanus

- C. tetani infection
- " Lock-jaw"
- Caused by exotoxin
- Treatment: immunization

❖ Post-Operative Infections

♦ Fever After Surgery

♦ The "Five W's" "possible causes for postoperative fever":

- Wind: Atelectasis = collapsing of lungs
- Water: UTI (Urinary Track Infection)
- Walking: DVT (Deep Vein Thrombosis)
- Wonder Drug: Medication Induced
- Wound: Surgical Site Infection
- Blood transfusion
- Preoperative misdiagnosis "pneumonia"
- **Malignant hyperthermia** "one of the important and most common causes, very important to ask about it in the family history

❖ Surgical Site Infections "SSI"

♦ 3rd most common hospital infection

♦ Incisional

1- Superficial
2- Deep

♦ Organ Space

- Generalized (peritonitis)
- Abscess

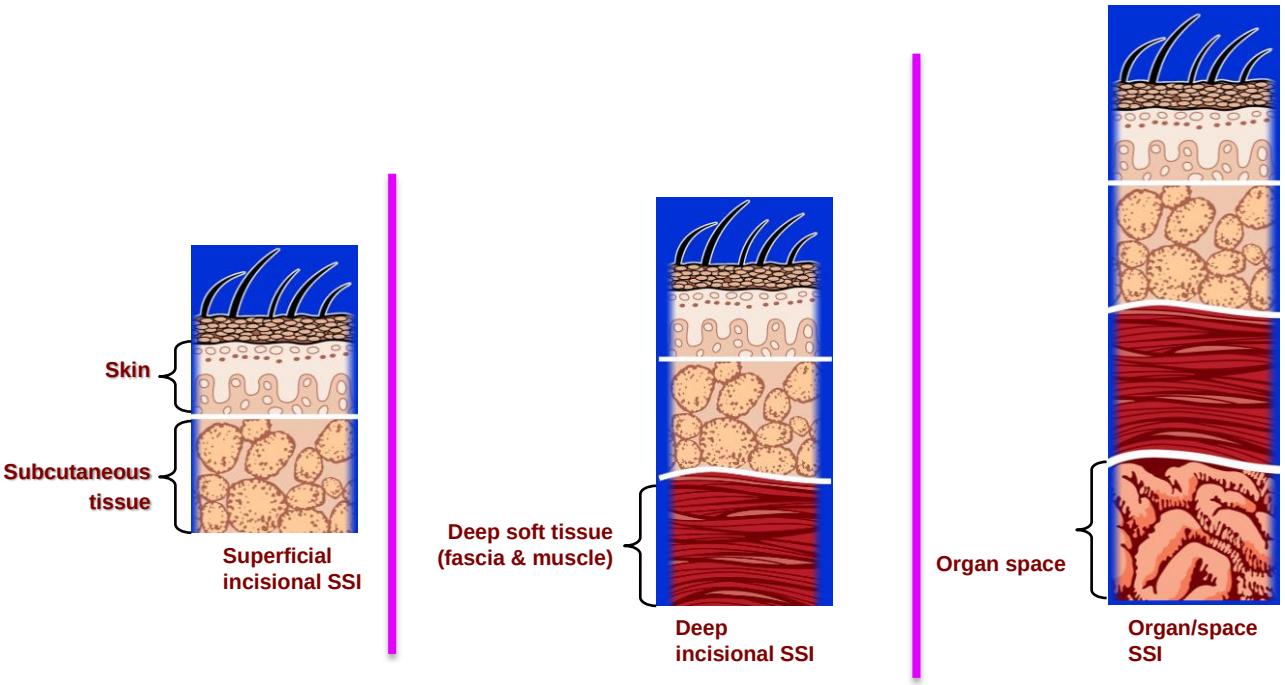
♦ Definition:

♦ Surgical sites are considered infected when there are:

- Systemic and local signs of inflammation.
- Bacterial counts ≥ 10^5 cfu/mL.
- Purulent versus nonpurulent

♦ The length of stay for the patient and economic effects of the hospital stay are important factors to consider in SSIs.

♦ Note that Surgical wound infection is SSI



1- Superficial Incisional SSI:

- Infection occurs within 30 days after the operation and involves only skin or subcutaneous tissue of the incision

2- Deep Incisional SSI:

- A more serious SSI. Extends past the superficial layer. The infection occurs within 30 days post-operation only if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and the infection involves the deep soft tissue, which include the fascia and muscle layers.

♦ Organ/Space SSI

- The most extensive of these surgical infections involves the organs and the space surrounding the organs. These infections can occur within **30 days** post-op if no implant is left in place or within **1 year** if an implant is in place and the infection appears to be related to the operation and the infection involves any part of the anatomy, other than the incision, which was opened or manipulated during the operation.

♦ SSI – Risk Factors:

● Operation Factors:

- Duration of surgical scrub.
- Maintenance of body temperature.
- The use of skin antisepsis.
- Preoperative shaving.
- Duration of operation.
- Antimicrobial prophylaxis.
- Operating room ventilation.
- Inadequate sterilization of instruments.
- Foreign material at surgical site.
- Surgical drains.
- Surgical technique, Poor surgical technique includes:
  - Poor hemostasis.
  - Failure to obliterate dead space.
  - Tissue trauma.

● Patient Characteristics

- Advanced age
- Diabetes
  - HbA_{1C} and SSI
  - Glucose > 200 mg/dL postoperative period (<48 hours)
- Nicotine use: delays primary wound healing
- Steroid use: controversial
- Malnutrition: no epidemiological association
- Obesity: 20% over ideal body weight
- Prolonged preoperative stay: surrogate of the severity of illness and comorbid conditions
- Preoperative nares colonization with *Staphylococcus aureus*: significant association
- Perioperative transfusion: controversial
- Coexistent infections at a remote body site
- Altered immune response

● Perioperative Glucose Control:

- Patients with a blood sugar > 300 mg/dL during or within 48 hours of surgery had more than 3times the likelihood of a wound infection

● Pre-operative Shaving

● Shaving the surgical site with a razor induces small skin lacerations

- Potential sites for infection
- Disturbs hair follicles which are often colonized with S. aureus
- Risk greatest when done the night before

- Patient education
  - Be sure patients know that they should not do you a favor and shave before they come to the hospital!

❖ Prophylactic Antibiotics

- Antibiotics given "IV" for the purpose of preventing infection when infection is not present but the risk of postoperative infection is present.
  - Decreases bacterial counts at surgical site
  - Given within 30 minutes prior to starting surgery
  - Vancomycin 1-2 hours prior to surgery
  - Redose for longer surgery
  - Do not continue beyond 24 hours
- ♦ Surgical site prevention:
  - Use antibiotics appropriately
  - Maintain normal Body temp
  - Maintain normal Blood glucose
  - Optimize oxygen tension
  - Avoid shaving Site

❖ Treatment

- **Incisional:** open surgical wound, antibiotics for cellulitis or sepsis
- **Deep/Organ space:** Source control, antibiotics for sepsis

❖ Types of Surgery: "very important"

Type of surgery	Surgery	Risk for infection
Clean	Hernia repair Breast biopsy	1.5%
Clean-Contaminated	Cholecystectomy Planned bowel resection	2-5%
Contaminated	Non-preped bowel resection	5-30%
Dirty/infected	Perforation, Abscess, Trauma	5-30%

❖ Occupational Blood Bourne Virus Infections

	HBV	HCV	HIV
Risk from Needle stick	30%	2%	0.3%
Chemoprophylaxis	Yes	No	Yes
Vaccine	Yes	No	No

Question: To prevent infection developing in a lower limb wound sustained 8 hrs ago in a road accident, the single most action is:

A. Adequate wound debridement
B. Application of topical antibiotic before wound closure
C. Giving broad spectrum antibiotic
D. Immediate wound closure

Answer: A