SURGICAL INFECTION

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GENERAL CONSIDERATIONS

• Surgical infections: infections that require operative treatment or result from operative treatment.

• Infections that require operative treatment include

  1. necrotizing soft tissue infections.

  2. body cavity infections such as peritonitis, suppurative pericarditis, and empyema.

  3. confined tissue, organ, and joint infection such as abscess and septic arthritis.

  4. prosthetic device-associated infections.
Infections that result from operative treatment include

- Wound infection,
- Postoperative abscess,
- Postoperative (tertiary) peritonitis,
- Other postoperative body cavity infection,
- Prosthetic device–related infection,
- Other hospital-acquired infections:
  - pneumonias, urinary tract infection, and vascular catheter–related infection.
Host defenses and antibiotic therapy are adequate to overcome most infections.

Operative treatment:

Host defenses cannot function properly.

Continuing contamination with microorganisms:

- Infected fluid collections.
- Infected necrotic tissue.
- Infected foreign bodies.
Determinants of Infection

- Development of surgical infection depends on:
  
  1. Microbial pathogenicity and number
  
  2. Host defenses
  
  3. Local environment
  
  4. Surgical technique (for postoperative infection).
Determinants of Infection

Host Defenses

• Local Host Defenses

A layer of epithelium

Skin: multilayered, the superficial layers are keratinized.

Nasopharynx, oral cavity, esophagus, and genitourinary tract.: multilayered

The flushing action of tears and urine, cilia (trachea, bronchi), peristalsis, mucus, pH (gastrointestinal tract), and local immunity (IgA).
A complex system of defense mechanisms exists throughout the body that can inactivate and kill microbial agents. Consist of:

- Phagocytic cells.
- Immune system.
- Other molecular cascades: complement system, coagulation system, kinin system.
Determinants of Infection

Local Environmental Factors

- Inhibit systemic host defenses from being fully effective.
  
  Devitalization of tissue
  
  Foreign bodies
  
  Fluid collections and edema
  
  Peripheral vascular disease
  
  Shock

  The lowered PO 2 : inhibits phagocytosis and promotes the growth of anaerobes.
Handling tissues gently;
Removing devitalized tissues, blood, and other substances that promote the growth of microbes.
Using drains appropriately.
Avoiding excessive cautery.
Not performing intestinal anastomoses under tension.
TYPES OF SURGICAL INFECTIONS
SOFT TISSUE INFECTIONS
IMPETIGO

- Disease limit at epidermis
- 2 separated clinical forms
  - 1. Bullous impetigo
  - 2. Epidermal impetigo
BULLOUS IMPETIGO
EPIDERMAL IMPETIGO
**Impetigo**

- **Diagnosis**
  
  Identify organism by aspiration fluid in vesicle for Gram stain: *S. aureus* or streptococcal morphology

- **Treatment**
  
  Improve hygiene

  Remove crust with soap and water

  Topical antibiotic
ERYSIPelas

- Superficial infection of the skin with extensive lymphatic involvement
- Almost always due to Streptococcus pyogenes and other streptococcus
- Infants, children, elderly: most common

Pre-existing lymphatic obstruction, edema from LN dissection
ERYSIPelas

- Clinical manifestation
  - Pain, swelling, well demarcated margin
  - Fever, Leukocytosis
  - Not invade through dermis
  - Frequently occur beside the nose and cheek
  - Elephantiasis-like syndrome in chronic case: from chronic lymphatic obstruction
ERYSIPelas

• **Treatment**

  Antibiotic : Penicillin group.

  In extensive case : admit , Parenteral antibiotic
CARBUNCLE

Confluent infection of multiple contiguous follicles, the infection is limited to the subcutaneous tissue by thick overlying skin and dense subcutaneous fascia.

Cause from S. aureus

Begin as furuncle on the back of neck, axilla, or pubic region then spread into adjacent follicle and penetrate to the subcutaneous result in abscess with multiple tract
CARBUNCLE

- Clinical: look sick, high fever, pain and swelling of skin overlying carbuncle
- Always treated with antibiotic and I&D.
  - Cruciate incision on the abscess
  - Dissect under the flap for adequate drainage
- May be recurrent
Hidradenitis Suppurativa

- Inflammation disease of the apocrine gland-bearing area.
- Chronically, relapsing nature.
- Rare before puberty (apocrine gland do not reach functional status until the age of puberty)
- Most common: axilla
Hidradenitis Suppurativa

- Pathophysiology
Treatment

Medical therapy in acute stage: symptomatic relief and control of local infection, broad spectrum antibiotic, good personal hygiene, avoidance of tight-fitting cloth, drainage.

The most effective treatment: surgical management

Adequate excision of disease skin and adjacent apocrine gland bearing tissue.

Cover the defect by split thickness skin graft (STSG)
CELLULITIS

• An acute expanding infection of the skin and subcutaneous tissue characterized by warm, erythema and edema.

• *Streptococcus pyogenes*, *staphylococcus aureus*, other Gm positive pyogenic cocci (such as *S. Pneumoniae*) and Gm negative bacilli.

• All layer of skin and subcutaneous tissue are acutely inflammed and infiltrated with polymorphonuclear leukocyte
CELLULITIS

• Management

Culture purulent material from the lesion.

Inject 0.5 ml of NSS into the erythematous margin and aspirate the content for culture. (recommend in severe case)

Early simple case: Treated with parenteral penicillin G.

Severe case or immunocompromised host: add aminoglycoside or agent that cover Gm negative pathogen.
CELLULITIS

• Management

  Antibiotic: Penicillin G (Strept.)

  Cloxacillin (Strept + Staph)

  Alternative: First gen ceph, Vancomycin, Clindamicin.

  Immunocompromised host: should add aminoglycoside

  Local care: No incision and drain.

  Immobilization, elevation, warm compression.
SUBCUTANEOUS ABSCESS

Etiology

S. aureus : upper part of body

Anaerobe : mixed organism

perineum, inguinal, buttock

Enteric gm negative + anaerobe : nonperineal area

Proteus mirabilis, E.Coli.

Sterile abscess : very few (except: previous antibiotic, inappropriate collection of specimen, foreign body)
SUBCUTANEOUS ABSCESS

• Clinical manifestation

  Induration, Fluctuation

  Pain and swelling around the infected site.

  Cellulitis, lymphedema, lymphangitis and regional lymphadenopathy

  Less systemic symptom, low grade fever

  Needle aspiration may be useful in questionable case
SUBCUTANEOUS ABSCESS

• Treatment
  • Antibiotic

  Parenteral antibiotic:

  1. Sepsis: high fever, tachycardia

  2. Abscess in critical area: Mastoid area, central triangle of face (drain to carvernous sinus)

  3. Risk from systemic disease: rheumatic heart, Hodgkin disease, severe diabetes

  4. Immunocompromised host.
NECROTIZING FASCIITIS

• Definition
  Infection of subcutaneous tissue, which spread in the fascial clefts overlying deep fascia and sparing the skin. Skin gangrene result only after the vessels to the skin thrombose.

• Etiology
  Streptococcus, staph.
  Most often: a synergistic bacterial infection: polymicrobial (aerobe + anaerobe)
NECROTIZING FASCIITIS

- **Presentation**

  Portal of entry is obvious: Trauma, postoperative wound infection, perianal abscess, etc.

  Early: Large area of pain, swollen, erythema, fever.

  If left untreated: necrosis of skin, paresthesia, subcutaneous crepitation, bleb at the skin, hypotension jaundice.
• In questionable case: Probing instrument through the area of necrosis or small incision between subcutaneous tissue and deep fascia.
NECROTIZING FASCIITIS

• Treatment

1. Supportive symptomatic

Fluid resuscitation, adequate oxygenation, correct acidosis, pain control.

2. Adequate antibiotic

Depend on Gm stain.

Empirical treatment: Penicillin G + aminoglycoside + Clindamycin.
3. Definitive surgery

Most important.

Debridement: incision should extend to expose normal fascia, preserve viable skin flap. Packed loosely with moist gauze.

Repeat exam the wound daily.

Redebride the wound if necessary.

Closure the defect by Skin graft if infection subside.
## Cellulitis VS Necrotizing fasciitis

<table>
<thead>
<tr>
<th></th>
<th>Cellulitis</th>
<th>Necrotizing fasciitis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initiating picture</strong></td>
<td>Generalized malaise, fever, weakness</td>
<td>More seriously (may be sepsis)</td>
</tr>
</tbody>
</table>
| **Wound assessment**  | Wound edema, skin: red, warm, Vesicle may be present in untreated patient | Early: wound edema, associated with thin serum from lesion
Late: Large area of edema, necrosis of skin, crepitation may occur |
| **Patient’s comfort** | Tenderess around, pruritus common                                           | Extreme pain often out of proportion to wound. |
| **Resolution**        | Significant resolution of sign and symptom within 24–48hrs. of antibiotic treatment | Little or no resolution of sign and symptom after antibiotic treatment |
FOURNIER’S IDIOPATHIC GANGRENE

• Infection of subcutaneous tissue of perineum cause gangrene of the skin and subcutaneous tissue.

• Streptococcus pyogenes, S. aureus, with Facultative enteric organism (E.coli, Klebsiella, Enterococci).

May have synergistic anaerobic bacteria (Bacteroides, Peptostreptococcus).
FOURNIER’S IDIOPATHIC GANGRENE

• **Treatment**

  Broad spectrum antibiotic (IV form) same as necrotizing fasciitis

  Debridement the necrotic skin, carefully preserve blood supply to testis.

  If infection subside: closure by suture or skin graft.
MYONECROSIS

- Infection of muscle caused necrosis of muscle

- Divided into 2 groups
  1. Clostridial myonecrosis
  2. Nonclostridial myonecrosis
MYONECROSIS

- Clostridial myonecrosis

- Etiology

  80-90% C. Perfringens, 10% C. Septicum

  5% C. Bifermentans, C. Histolyticum and C. Phallax.
MYONECROSIS

• Clostridial myonecrosis

• Presentation

Incubation period: 6 hours - 3 days.

Abrupt onset, severe pain (like arterial occlusion)

Edema, cold skin, tenderness on pressure, Muscle edema herniate through wound, serosanguineous discharge, Gas bubble, crepitation, Bleb may occur at the skin.

Severe systemic toxicity, Shock, renal failure, sepsis.
MYONECROSIS

• Clostridial myonecrosis

• Diagnosis

  Clinical finding

  Radiologic exam: Plain film, CT, MRI

  air in soft tissue

  Serum creatine phosphokinase (CPK) level

  Operative exploration in questionable case: smell, color, bleeding, contractility of muscle
MYONECROSIS

• Clostridial myonecrosis

• Treatment

General support

Antibiotic: Penicillin G high dose

Alternative: Metronidazole, aminoglycoside + Clindamycin.
MYONECROSIS

• Clostridial myonecrosis

Emergency surgery:
Debridement of all necrotic tissue, Noncontracted muscle
Fasciotomy: reduce pressure in fascial compartment

Amputation: Indication
1. Massive gangrene of muscle, unstable vital sign
2. Compound fracture with gas gangrene
3. Main vascular injury with gas gangrene
Hyperbaric oxygen therapy (HBO)

- Administration of 100% oxygen at greater than atmospheric pressure to produce arterial hyperoxia.
- May be benefit in necrotizing soft tissue infection.
- Diminished tissue loss, decrease mortality rate.
- Should be used as adjunctive with debridement and antibiotic.
- Complication: Barotrauma, tympanic membrane rupture, pneumothorax, air embolism, oxygen toxicity.
• Monoplace chamber
• Multiplace chamber
<table>
<thead>
<tr>
<th></th>
<th>Clostridial myonecrosis</th>
<th>Nonclostridial myonecrosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset</td>
<td>Acute (may be in 6 hr to 3 days following injury)</td>
<td>Over several days</td>
</tr>
<tr>
<td>Pain</td>
<td>Severe and appears early</td>
<td>May be severe later in illness</td>
</tr>
<tr>
<td>Tissue gas</td>
<td>Present</td>
<td>Rare</td>
</tr>
<tr>
<td>Odor of exudate</td>
<td>Slightly foul or</td>
<td>Variable : may be foul</td>
</tr>
<tr>
<td></td>
<td>Peculiar sweet</td>
<td></td>
</tr>
<tr>
<td>Cutaneous changes</td>
<td>Bronze discoloration, Edema, bullae and necrosis</td>
<td>Erythema</td>
</tr>
<tr>
<td>Systemic toxicity</td>
<td>Extreme and evident early</td>
<td>Present only late</td>
</tr>
<tr>
<td>Progression</td>
<td>Extremely rapid</td>
<td>Slow</td>
</tr>
<tr>
<td>Gm stain</td>
<td>Gram positive rods and few neutrophiles</td>
<td>Gram positive cocci in chain and numerous neutrophiles</td>
</tr>
</tbody>
</table>
**TETANUS**

*Clostridium tetani,* (gram-positive spore-forming bacillus).

Breaks in the mucosal or skin barriers.

**Tetanospasmin:**

Anterior horn cells of spinal cord & brainstem.

Blocks inhibitor synapses, leading to muscle spasms and hyperreflexia.

**Tetanolysin:**

Cardiotoxic, hemolysis

Not major clinical importance.
Spore

Vegetative cell
TETANUS

The median incubation: 7 to 8 days.

Generalized tetanus

Initial symptoms are variable.

Restlessness and headache.

Muscle spasms, discomfort in neck, lumbar & jaws.

Swallowing difficult.

Stiff neck.

Orthotonos.
TETANUS

Generalized toxic convulsions are frequent, exhausting, and unpredictable.

Any slight external stimulus (a breeze, sudden movement, noise, or light) and internal stimuli (cough, swallow, distended bladder) may trigger generalized convulsions.
TETANUS

Treatment

Tetanus immunoglobulin (TIG) 500 to 10,000 units.
Intensive care unit. Quiet rooms.
Sedation, muscle relaxants. Adequate doses of analgesics.
Adequate nutrition, Laxatives, Urinary catheter, Eye protection.
Debridement of wound.
Penicillin G
**TETANUS**

**Prevention**

**TABLE 5-2 Summary of Immunization Practices Advisory Committee Recommendations for Tetanus Prophylaxis in Routine Wound Management**

<table>
<thead>
<tr>
<th>History of Adsorbed Tetanus Toxoid (Doses)</th>
<th>Clean Minor Wounds</th>
<th>All Other Wounds</th>
<th>Td</th>
<th>TIG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown or &lt; 3 doses</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>≥ 3 doses</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

*a* Recommendation for Td and TIG depends on local epidemiology and availability.

*b* Td = Tetanus Toxoid.

*c* Recommendation for Td and TIG depends on clinical judgment and risk assessment.

*d* No recommendation for TIG in this situation.

*e* TIG not recommended in routine wound management.
BODY CAVITY INFECTION
Primary peritonitis

Caused: single organism

Most common: young children and adults with ascites or renal failure

Treated with antibiotics.
Secondary bacterial peritonitis

Result of a defect in GI tract, requires operative intervention.

Treatment: surgery (control the source of contamination, remove bacteria and adjuvant materials from the peritoneal cavity).

Antibiotic therapy
Peritonitis and Intraabdominal Abscess

- Tertiary peritonitis

  Peritonitis-like syndrome result of a disturbance in the host's immune response

  Characterized by peritonitis without evidence of pathogens or peritonitis caused by fungi or low-grade pathogenic bacteria.
PROSTHETIC
DEVICE-ASSOCIATED
INFECTIONS
PROSTHETIC DEVICE-ASSOCIATED INFECTIONS

• Cardiac valves, pacemakers, vascular grafts, and artificial joints.

• Associated with great morbidity.

• Complete removal of all foreign material and antibiotic therapy.

• Vascular grafts: may be salvaged by debridement, povidone-iodine–soaked dressings, and antibiotic therapy when the suture line has not been infected.

• Infected prosthetic joints and pacemakers: may be salvaged by antibiotic irrigation of the joint or pacemaker.
HOSPITAL-ACQUIRED
(Nosocomial)
INFECTIONS
Hospital-acquired infections are infections that develop within a hospital or are acquired within a hospital.

On surgical services urinary tract infections are most common, followed by wound infection, lower respiratory infection, bacteremia, and cutaneous infection.
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Classification of Operative Wounds

Clean

- Elective, primarily closed, and undrained
- Nontraumatic, uninfected
- No inflammation encountered
- No break in asepsis
- Respiratory, alimentary, genitourinary, or oropharyngeal tracts not entered.
Wound Infections

Clean-contaminated

- Alimentary, respiratory, or genitourinary tracts entered under controlled conditions without unusual contamination
- Appendectomy
- Oropharynx entered
- Vagina entered
- GU tract entered in absence of culture-positive urine.
- Biliary tract entered in absence of infected bile.
- Minor break in technique.
- Mechanical drainage.
Wound Infections

Contaminated

- Open, fresh traumatic wounds.
- Gross spillage from gastrointestinal tract.
- Entrance of GU or biliary tracts in presence of infected urine or bile.
- Major break in technique
- Incisions in which acute nonpurulent inflammation is present
Wound Infections

Dirty and Infected

Traumatic wound with retained devitalized tissue, foreign bodies, fecal contamination, or delayed treatment, or from a dirty source

Perforated viscus encountered

Acute bacterial inflammation with pus encountered during operation
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

- Wound infection rates in large series are

  1.5 to 3.9 percent for clean wounds.

  3.0 to 4.0 percent for clean-contaminated wounds.

  8.5 percent for contaminated wounds.

  28 to 40 percent for dirty wounds
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Definition

An incisional (superficial) wound infection:
within 30 days after operation
involves skin or subcutaneous tissue above the fascial layer and:

(1) Purulent drainage
(2) An organism
(3) The wound is opened deliberately by the surgeon, unless the wound is culture-negative.
Deep surgical wound infection:
within 30 days (no prosthesis) and within 1 year (implant)

Infection involves beneath the fascial layer and:

1. Spontaneously dehiscens or opened by surgeon when the patient has a fever (>38 °C)
2. An abscess, evidence of infection directly under the incision.
3. The surgeon diagnoses infection.
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Prophylaxis

• Operating Room Environment

  Air-handling systems

  Filtration of air.

  Operating room air should have a positive pressure relative to air in the corridors.

  Special laminar flow systems with high efficiency particulate air (HEPA).

  Reducing the number of people

  Limiting talking
Instruments and Drapes

Properly sterilized instruments

Wet drapes

Adhesive plastic drapes do not lower the incidence of wound infection.
MOIST HEAT
Drape
Hand Washing

Removes dirt and desquamated skin and reduces the number of microbes on the skin.

Tradition: scrubbing for 10 min, 2 brushes.

Washing 5 min, 1 brush: equal reduction in skin bacterial counts.
Hand washing
Hand washing

1. Palm to palm
2. Right palm over left dorsum and left palm over right dorsum
3. Palm to palm fingers interlaced
4. Backs of fingers to opposing palms with fingers interlaced
5. Rotational rubbing of right thumb clasped in left palm and vice versa
6. Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa. Wrists are similarly rubbed.
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Prophylaxis

- Gloves

30% of gloves have defects by the end of the operation.

The CDC: wearing two pairs of gloves to reduce the likelihood of exposure to patient's blood.
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Prophylaxis

• Other Barriers

Caps: prevent hair and skin scales (and adherent bacteria).

Masks: prevent droplets produced during speaking or coughing.

Gowns: prevent desquamated skin and other particles.
Operative clothes, cap, mask and footwear
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Prophylaxis

• Preoperative Stay

Longer preoperative hospitalizations: more likely to develop postoperative wound infections.
Preoperative Shower

A shower with an antiseptic soap can reduce the resident skin bacteria.

No reduction in wound infection rates in patients who had a preoperative shower.
Remote Infections can triple the rate of wound infection. Elective operations should be delayed until the dermatitis is treated, especially if the skin incision is near or through such regions.
Herpes
Hair Removal

Nicks and cuts caused by shaving are sites where bacteria can proliferate.

When shaving is done the night before operation, the wound infection rate is higher than when shaving is done in the operating room immediately before operation.

Clipping with an electric clipper is better.
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Prophylaxis

- **Skin Preparation**

  5-min scrub with povidone-iodine followed by painting with povidone-iodine solution.
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Prophylaxis

- Improving Host Defenses
  - Malnutrition
  - Obesity
  - Cirrhosis.
  - Uremia
  - Diabetes
  - Smoking
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Prophylaxis

- **Prophylactic Antibiotics**

  Clean operations: Staph. aureus, Staph. epidermidis, and gram-negative enteric bacteria

  Gram-negative enteric bacteria: Gastro-duodenal and biliary tract procedures, colorectal surgery, appendectomy, and gynecologic surgery.
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Prophylaxis

Antibiotics should generally be given intravenously 30 to 60 minutes before operation.

Antibiotic dose should be repeated if

1. The operation lasts longer than 4 h
2. Twice the half life of the antibiotic
3. Blood loss has been great.

Should not be continued beyond the day of operation.
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Prophylaxis

• Indications for prophylactic antibiotic

  1. Bacterial contamination of the wound is likely
  2. Clean operations with prosthetic device.
  3. Traumatic wounds.
  4. Intestinal tract has been entered.
  5. Elective operations on the intestine or colon.
  6. Gastroduodenal operations with increased gastric flora.
  7. High-risk biliary tract operations.
  8. Gynecologic operations.
The bacteria in the stomach are increased in

1. Gastric outlet obstruction,

2. Decreased gastric acidity (achlorhydria, antacid or H2-receptor blocker therapy, gastric cancer)

3. Normal or high acidity if bleeding has occurred.
HOSPITAL-ACQUIRED (Nosocomial) INFECTIONS

Wound Infections

Prophylaxis

High-risk biliary tract operations

1. Jaundice, bile duct obstruction, stones in CBD.
2. Reoperative biliary tract operation.
3. Acute cholecystitis.
4. Age greater than 70 years.