Objectives

- Identify host factors that prevent skin and soft tissue infections, and factors that could predispose to infection
- Identify pathogens that commonly cause typical skin and soft tissue infections
- Suggest empiric antimicrobial therapy for typical skin and soft tissue infections
Introduction

- Skin/soft tissue infections are common and vary widely in severity
  - Can involve any or all layers of skin, fascia and muscle

- Many classification systems, based on:
  - Infection local or diffuse
  - Systemic signs
  - Necrotizing
  - Infecting organism

- Important to have an idea of what the infecting organism is, and determine appropriate empiric antibiotic therapy where necessary
Skin Composition & Host Defenses to Infection

- Multilayered construction of skin
  - Stratum corneum, epidermis, dermis, subcutaneous fat, superficial fascia
- Skin is dry, continuously renewed
- Limited epithelial cell adherence by pathogens
- Intact stratum corneum (acts as a barrier)
- Low skin pH (normally about 5.5)
- Host immune system (IgA and IgG production in sweat)
- Resident skin flora (competitive inhibition)
Factors that Could Predispose to SSTI

- Damage to corneal layer allowing bacterial penetration
- High conc. of bacteria (>10^5)
- Excessive skin moisture
- Occlusion of blood supply to skin
- Obesity
- Blood dyscrasias
- Corticosteroid use
- Neutrophil function defects
- Paraparesis
- Diabetes
- Alcohol Abuse
Bacteria Associated with SSTIs

- **Gram-positive**
  - *S. aureus, S. epidermidis*
  - *Streptococci* spp.

- **Gram-negative**
  - *E. coli, Klebsiella, Proteus*
  - *Pasturella multocida*

- **Anaerobes**
  - *Eikenella corrodens*
  - Other oral anaerobes
  - *Clostridium* spp.
  - *B. fragilis*
Impetigo & Ecthyma

- **Pathogenesis**
  - Bacteria invades normal skin via minor wounds (e.g., insect bites, abrasions), develops in approximately 10 days
  - More common in hot, humid, summer weather
  - Can be communicable
    - Spread facilitated by crowding, poor hygiene
  - Ecthyma similar to impetigo, but tends to penetrate through the epidermis

- **Bacteria**
  - Usually group A streptococci
  - Occasionally *S. aureus*
Impetigo & Ecthyma

- **Clinical findings of impetigo**
  - Small, superficial lesions: purulent discharge dries forming thick, golden yellow crusts
  - Occurs principally around mouth and nostrils

- **Clinical findings of ecthyma**
  - Small, “punched-out” ulcers covered by greenish yellow crusts, extending deeply into the dermis and surrounded by raised margins
    - Most frequently in lower extremities
    - Particularly in children and elderly

- Lesions usually painless, but pruritus is common; can lead to spreading of the infection
Impetigo
Impetigo & Ecthyma

- Antimicrobial therapy (7-10 day duration)
  - β-lactams
    - PCN VK 25 – 50 mg/kg/day (250-500 mg) QID x10d
    - Single dose benzathine PCN G 300-600,000 U peds, 1.2 MU adults
    - Cephalexin 500 mg QID x10d
    - Cefaclor 500 mg TID x10d
    - Cefprozil 500 mg BID x10d
  - PCN allergy
    - Emycin 30-50 mg/kg/day (250-500 mg) QID x10d
- Prophylaxis
  - Mupirocin or triple antibiotic ointment topically to lesions/insect bites can help prevent pyoderma, esp. if young children in close contact in outbreak
Carbuncle & Furuncle

- **Pathogenesis**
  - Furuncle is acute inflammation of subcutaneous layers of skin, gland, or hair follicles.
  - Carbuncle is more extensive extending into subcutaneous fat and developing into multiple abscesses.
Carbuncle & Furuncle

- Clinical findings
  - Furuncles
    - Occur in skin areas subject to friction and perspiration containing hair follicles (neck, face, buttocks)
  - Carbuncle
    - Larger, deeper, indurated lesion typically at nape of neck, on back, or on thighs
    - Often occur along the course of multiple hair follicles and may be associated with fever and malaise.
Carbuncle
Carbuncle & Furuncle

- **Etiology**
  - *S. aureus*

- **Non-pharmacologic therapy**
  - **Furuncle**
    - Most treated with moist heat, promoting localization and drainage of the process
  - **Carbuncle/furuncle with surrounding cellulitis**
    - Require antistaphylococcal antibiotic
    - Surgical drainage for large and fluctuant lesions
Carbuncle & Furuncle

- **Antimicrobial therapy**
  - **Oral**
    - Cephalexin 500 mg QID x10d
    - Cefaclor 500 mg TID x10d
    - Cefprozil 500 mg BID x10d
    - Oxacillin 750 mg QID x10d
  - **IV**
    - Cefazolin 1-2 g q8h
    - Nafcillin 1-1.5 g q4h
  - **PCN allergy**
    - Clindamycin 150-300 mg PO QID x10d
    - Erythromycin 250-500 mg PO QID x10d
Erysipelas

- **Pathogenesis**
  - Bacterial invasion of normal skin via minor trauma (e.g., insect bites, abrasions), to form distinctive cellulitis with prominent lymphatic involvement

- **Clinical findings**
  - Acute febrile disease with localized inflammation and redness of skin and subcutaneous tissue
  - Sharply demarcated bright red rash commonly affecting bridge of nose and cheeks
  - Associated with systemic symptoms: chills, fever, rigor, malaise
  - More common in infants, young children, elderly
  - Most commonly on face; also on extremities, genitalia
Erysipelas

- **Etiology**
  - Almost always *S. pyogenes* (group A)
  - Group B streptococci can be seen in newborns
  - Rarely *S. aureus*
Erysipelas

- Antimicrobial therapy (7-10 days; pts should improve dramatically in 24-48h)
  - Oral
    - PCN VK 25-50 mg/kg/d QID x10d (250-500 mg QID)
    - Dicloxacillin 500 mg QID
    - Cephalexin 500 mg QID x10d
    - Cefprozil 500 mg BID x10d
  - IV
    - PCN 1 MU Q6h IV
    - Cefazolin 1 g IV q8h
    - Nafcillin or oxacillin 2 g IV q4h
  - PCN allergy
    - Emycin 30-50 mg/kg/day (250-500 mg) QID PO x10d
Cellulitis

- **Pathogenesis**
  - Previous trauma (laceration, puncture wound) or underlying skin lesion (furuncle, ulceration) predisposes development of cellulitis
  - Acute spreading of infection of the skin extending deeper than erysipelas to involve the subcutaneous tissues
  - Inflammation spreads through the tissue

- **Value of culture**
  - Not usually positive (only in 15-25% of patients)
  - More necessary in IVDA, who might be bacteremic
  - Also, immunocompromised patients, previous failure, hospitalized patients
Cellulitis

- **Clinical findings**
  - Within hours to days of inciting trauma, have local tenderness, pain, erythema, develop and rapidly intensify
  - Malaise, fever, chills
  - Lesion is red, hot, and swollen with poorly demarcated borders.
  - Regional lymphadenopathy
  - Bacteremia
  - Serious disease, since disease has propensity to spread via lymphatics and blood stream
Cellulitis

- **Etiology**
  - *S. aureus* and *S. pyogenes* are primary pathogens
  - Gram-negatives possible; might suspect in immunocompromised patients, or those who failed previous therapy
  - Cellulitis due to group A streptococcus may occur as a post-op wound infection
    - Common, but noteworthy as the infection can spread rapidly and invade bloodstream
    - Can manifest within 6-48 hours of surgery
    - HOTN, often due to bacteremia, may be initial sign of infection before significant erythema is evident
Cellulitis

- Antimicrobial therapy (expect some response in 1-2 days; usual duration 7-10d)
  - Oral
    - Cephalexin 500 mg QID x10d
    - Cefprozil 500 mg BID x10d (more $$)
    - Oxacillin 750 mg QID x10d
    - Dicloxacillin 500 mg QID x10d
  - IV
    - Cefazolin 1-2 g q8h
    - Nafcillin 1-2 g q4-6h
  - PCN allergy
    - Clindamycin 300 mg PO QID x10d
    - Erythromycin 500 mg PO QID x10d
Cellulitis: Antibiotics if Mixed Infection (or Gram-Negative) Suspected

- Reasons mixed infection might be present or suspected
  - Immunocompromised
  - DM
  - Treatment failure

- Antibiotic therapy
  - Nafcillin IV + aminoglycoside (or ciprofloxacin)
  - Gram-negative only: cefuroxime PO, aminoglycoside, 1st or 2nd generation cephalosporin IV
  - Polymicrobial: Augmentin PO, aminoglycoside + clindamycin, monotherapy with imipenem or meropenem
Cellulitis

- Antimicrobial therapy
  - High risk (HD and underlying debilitating disease patients)
    - Nafcillin 1-1.5 g IV q4h and gentamicin
    - Clindamycin 900 mg IV q8h and ciprofloxacin 400 mg IV q12 h
  - MRSA
    - Vancomycin 1 g IV q 12h
    - Synercid 7.5 mg/kg q 8-12h
    - Linezolid 600 mg BID
Necrotizing SSTI

- Progressive necrosis of skin, underlying tissue
  - Edema beyond area of erythema
  - Skin blisters/bullae
  - Localized pallor, discoloration
  - Creptius

- Etiology
  - group A β hemolytic streptococci
  - *Pseudomonas*
  - *C. perfringens*
  - *B. fragilis*

- Treatment
  - Surgery
  - Clindamycin + aminoglycoside, possibly add PCN for severely ill patients to cover *C. perfringens*
Ciprofloxacin, levofloxacin have indications for SSTI

Coverage of *S. aureus*, particularly MRSA marginal

Not proven more effective than beta-lactams

Costly
Bite Wounds

- **Pathogenesis**
  - Estimated 4 million people bitten by dogs annually
    - Majority in extremities; facial bites more common in children <10 years of age
  - 40-50% of cat bites become infected

- **Human Bites**
  - Higher complication rate and infection rate (50%) than animal bites
  - Wounds to hand are more serious and more frequently become infected than bites to other areas
  - Clenched fist wounds required surgical exploration by experienced surgeon and antimicrobial therapy
Bite Wounds

- Clinical findings
  - Two distinct groups
    - Those presenting at 8-12 hours post bite
      - Might only need general wound care, tetanus, rabies if necessary
    - Those presenting >12 hours after injury
      - Usually have an established infection, manifested by localized cellulitis, pain at injury site, and purulent discharge (often gray and malodorous in case of *P. multocida*).
**Bite Wounds**

<table>
<thead>
<tr>
<th>Dog/cat bite wounds</th>
<th>Human Bite wounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>α hemolytic streptococci</td>
<td>Streptococci spp.</td>
</tr>
<tr>
<td>S. aureus</td>
<td>S. aureus, S. epidermidis</td>
</tr>
<tr>
<td>Pasturella multocida</td>
<td>H. parainfluenzae</td>
</tr>
<tr>
<td>β hemolytic streptococci</td>
<td>K. pneumoniae</td>
</tr>
<tr>
<td>anaerobes-- <em>Bacteroides</em> spp.</td>
<td><em>Eikenella corrodens</em></td>
</tr>
<tr>
<td>Various gram negative rods</td>
<td><em>Bacteroides</em> spp.</td>
</tr>
<tr>
<td></td>
<td><em>Fusobacterium</em> spp.</td>
</tr>
</tbody>
</table>
Bite Wounds

- Non-pharmacologic therapy
  - Tear and puncture wounds require copious irrigation, should be done ASAP
  - Surgical debridement and exploration considered on basis of examination
  - Immobilization and elevation of injured area essential

- Tetanus toxoid to those requiring a booster (>5-7 years since last immunization)

- Rabies should be considered with stray/wild animals (10 day observation period)
  - Contact local health department
Bite Wounds

- **Antimicrobial therapy**
  - Prophylaxis of non-infected animal wound not usually recommended, but, indications include:
    - Established infection
    - Wound to hand or near joints
    - Deep puncture wounds
    - Wound difficult to irrigate
    - Immunocompromised patient
    - Wound not well perfused
    - Age >50
    - (May not be needed for all dog bites--if wound well irrigated, and on lower extremity)
  - **Topical**
    - Triple antibiotic ointment (polymixin B/neomycin/bacitracin) only for minor, clean abrasions due to bite

*Prophylaxis for human bite wound to hand req’d*
Bite Wounds

- Antimicrobial therapy (concerned about *P. multocida*, *E. corrodens*?)
  - Oral
    - Amoxicillin/clavulanic acid 875/125 mg BID
    - Dicloxacillin 500 mg QID
    - Dicloxacillin 500 mg QID + PCN 500 mg QID
  - IV
    - Ampicillin/sulbactam 1.5 g q6h, then switch to oral
  - PCN allergy
    - Cefuroxime 500 mg PO BID
    - Clindamycin 300 mg PO QID
    - Doxycycline 200 mg PO BID
    - Levofloxacin 500 mg PO QD
  - Prophylaxis: 5d. Treatment: 7-14d.
Pathogenesis

- Involves major disruption of homeostasis
- Goal of early burn therapy is to ensure adequate delivery of oxygen, nutrients, and circulating cells to the wound
- Progressive tissue necrosis and limited defenses allow for microbial invasion of wounds
- Decreased body temperature due to heat loss may lead to progressive deterioration of the wound
- Patients with significant burns (<40%) are predisposed to infection due to nonspecific depression of humoral and cellular immune function
Burn Wounds

- **Etiology**
  - S. aureus
  - S. epidermidis
  - E. cloacae
  - E. coli
  - P. aeruginosa
  - Other gram-negative bacilli
  - Various streptococci
  - *Candida* spp.
  - *Aspergillus* spp.
Burn Wounds

- **Non-pharmacological therapy**
  - Based on burn severity and extent, surgical exploration and debridement may be warranted

- **Antimicrobial therapy**
  - **Topical:** Silver sulfadiazine/silver nitrate/sulfamylon (only for minor, clean, intact 1st degree burns)
  - **Oral:** Oxacillin 500-1000mg QID
  - **IV:** Nafcillin 1 g IV q4h
  - **MRSA:** Vancomycin 1g IV q12 h, Synercid, Linezolid
  - **Sepsis:** Vancomycin 1 g IV q12h + amikacin 10mg/kg LD, then 7.5 mg/kg IV q12h + pipercillin 4 g IV q4h
Case

- JM, 34 year old male, enters ER with 3-4 day hx of increasing pain at hip after a fall onto sidewalk while running.
- Has fever, weakness, lethargy, nausea
- Exam: very swollen, warm, and extremely tender hip. Temp 39.8°C (104°F), appears quite ill.
- Diagnosis of moderate to severe cellulitis
Would this patient be admitted to hospital?  
- Patient may be a candidate for admission

Suggest empiric antimicrobial therapy
- Nafcillin 2 gm IV Q6h
- Cefazolin 2 gm IV Q8h

Cultures?
- Wound site needle aspiration
- Blood culture

How long should IV be given?
- Once afebrile, and improved clinically for about 2 days
- Switch to PO, treat 10-14d
Case

- TE, 25 yo female, visits family doctor with 2-3 day history of worsening pain, redness, and swelling of left leg following a scrape
- Area is warm to touch, defined erythematous border
- Over past 24-36 hours, leg has become increasing painful and tight. Mild lymphadenopathy present. Temp 38.2°C (101°F)
- Diagnosis of moderate cellulitis
Case

- Should culture be obtained?
  » Probably not

- Should patient be given antibiotics?
  » Seems to be developing infection. Probably

- Which antibiotic
  » Dicloxacillin, cephalexin appropriate choices

- When should patient see response?
  » 1-2 days, but erythema may persist

- How long should treatment last?
  » 10 days