Skin and Soft Tissue Infections

Elizabeth D. Hermsen, Pharm.D.
Infectious Diseases Research Fellow
University of Minnesota
College of Pharmacy

Objectives

- Discuss three classification variables involved in the evaluation of skin and soft tissue infections (SSTI's).
- Identify five host defense mechanisms that may prevent SSTI's.
- List three predisposing factors for SSTI's.
- Differentiate between the various SSTI's
  - Identify pathogens commonly encountered with each type
  - Suggest antimicrobial therapy for common SSTI's

Introduction

- SSTI's are common and vary widely in severity
- Multiple classification systems
  - Uncomplicated vs. complicated
  - Single pathogen vs. mixed infection
  - Acute vs. chronic
  - Local vs. diffuse
  - Systemic signs
- Important to have an idea of what the infecting organism is appropriate empiric antimicrobial therapy when necessary
Host Defenses

- Multi-layered construction of skin
  - Stratum corneum, epidermis, dermis, subcutaneous fat, superficial fascia
- Skin is dry
- Limited epithelial cell adherence by pathogens
- Intact stratum corneum
- Low skin pH
- Host immune system
- Resident skin flora

Predisposing Factors

- Systemic
  - Peripheral neuropathy, vascular insufficiency
  - Increased age, smoking, poor nutrition, obesity
  - Comorbidities
    - Immunosuppression
- Local
  - Type, site, size, and depth of wound
  - Edema
  - Tissue ischemia
  - Excessive moisture

Classification of SSTI's

Primary (Uncomplicated)
- Folliculitis, furuncles, carbuncles
- Erysipelas
- Impetigo
- Cellulitis
- Necrotizing fasciitis

Secondary (Complicated)
- Diabetic foot infections
- Pressure sores
- Bite wounds
- Burn wounds
- Cellulitis
- Necrotizing fasciitis

Importance of Etiology
- Single pathogen
  - Usually uncomplicated/primary
  - Commonly gram-positive
- Mixed infection
  - Aerobes – usually open wounds
  - Aerobes and anaerobes –
    - Most likely deeper infections
    - Microbial synergy – severity

Bacterial Commonly Associated with SSTI’s

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

Gram-negative
- E. coli, Klebsiella, Proteus
- P. aeruginosa
- Pasteurella multocida

Anaerobes
- Eikenella corrodens
- Other oral anaerobes
- Clostridium spp.
- B. fragilis
Acute vs. Chronic

Acute
• External damage to intact skin
  – Cuts
  – Trauma
  – Bites
  – Burns
  – Surgical wounds

Chronic
• Endogenous mechanism and predisposing conditions
  – Leg/foot ulcers
  – Pressure sores

Folliculitis

• Pathogenesis
  – Superficial infection around hair follicles
  – Most common on hairy areas of the body
  – Can occur with insufficient chlorine levels in hot tubs/swimming pools

• Clinical findings
  – Pruritic, erythematous papules
  – ~48 hours after exposure
  – Evolve to pustules
  – Heals in several days

Folliculitis (cont.)

• Etiology
  – *S. aureus*
  – *P. aeruginosa* (hot tub)

• Treatment
  – Warm compress
  – May need topical antimicrobials (clindamycin, erythromycin)
Furuncles and Carbuncles

• Pathogenesis
  – Furuncles
    • Extension of folliculitis – inflammation involves dermis
    • Usually on hairy areas subject to friction and moisture (perspiration)
  – Carbuncles
    • Extension of furuncle – extends to subcutaneous tissue

• Clinical Findings
  – Furuncles
    • Firm, tender, red nodule
    • Painful, pustulant
    • Discrete lesions
  – Carbuncles
    • Similar to furuncle, but coalesced lesions
    • Fever, chills, malaise
    • May spread to other tissues

Furuncles and Carbuncles (cont.)

• Etiology
  – S. aureus

• Treatment
  – Small furuncles -- moist heat
  – Large furuncles/ Carbuncles
    • Dicloxacillin 250mg po QID x 10d
    • PCN allergy – clindamycin 150-300mg po QID or erythromycin 250-500mg po QID x 10d
    • Surgical incision for non-draining lesions

Erysipelas

• Pathogenesis
  – Superficial cellulitis
  – Bacteria gain access via small break in skin (insect bite, abrasion)

• Clinical Findings
  – Most common in infants, young children, and elderly
  – Most common on lower extremities
  – Bright red, edematous, indurated, painful
  – Sharply surrounded by a raised border
  – Fever and ↑ WBC common
Erysipelas (cont.)

- **Etiology**
  - *S. pyogenes*
  - Group B streptococci in newborns
  - Rarely *S. aureus*

Erysipelas (cont.)

- **Treatment**
  - Mild to moderate
    - procaine PCN G 600,000 U IM BID
    - PCN VK 250-500mg po QID x 10d
    - PCN allergy – erythromycin 250-500mg po QID x 10d
  - Serious
    - Aqueous PCN G 2-8 MU qd IV
    - Infection may appear to worsen shortly after treatment

Impetigo

- **Pathogenesis**
  - Most common in hot, humid weather
  - Bacteria gain access via minor trauma (insect bites)
  - Most common in children
  - Highly communicable – spread through close contact/poor hygiene

- **Clinical Findings**
  - Small, fluid-filled vesicles develop into pus-filled blisters
  - Purulent discharge dries to form "honey crusts"
  - Pruritis is common
Impetigo (cont.)

• Etiology
  – *S. aureus*
  – *S. pyogenes*

Impetigo (cont.)

• Treatment (7-10 days)
  – Warm water soak
  – PenVK 250-500mg po QID
  – Cephalexin 500mg po QID
  – Cefaclor 500mg po TID
  – Benzathine PCN G 1.2 MU IM x 1
  – PCN allergy – erythromycin 250-500mg po QID
  – Prophylaxis – mupirocin ointment TID x 7d

Cellulitis

• Pathogenesis
  – Acute; spreads to involve subcutaneous tissues
  – Previous trauma (laceration, puncture) or other skin lesion (furuncle, ulceration) predisposes to cellulitis
  – Propensity to spread to bloodstream
    • Bacteremia present in ~30% cases
  – Other complications
    • Local abscess and osteomyelitis
Cellulitis (cont.)

• Clinical Findings
  – Can occur within hours or days of initial trauma
  – Local tenderness, pain, erythema,
    • Rapidly intensifies
  – Fever, chills, malaise with severe cellulitis
  – Feels warm to touch, appears swollen, poorly demarcated
  – Regional lymphadenopathy
  – Cultures usually not positive (15-25% positive)

Cellulitis (cont.)

• Reasons to consider hospital admission
  – Pre-existing condition
  – Extensive or rapidly progressing
  – Presence of blisters, necrosis, or muscle involvement
  – High fever, rigors
  – Hypotension
  – Bite wound
  – Positive blood cultures (bacteremia)

Cellulitis (cont.)

• Etiology
  – *S. aureus*
  – *S. pyogenes*
  – Gram-negatives possible – consider in immunocompromised patients or patients who have failed previous therapy
  – IVDU – *S. aureus, S. pyogenes* most common, but also anaerobes and rarely, *Candida*
  – Diabetics – mixed aerobic/anaerobic flora, may progress to areas of gangrene
## Cellulitis (cont.)

### Treatment (usually 7-10 days)
- **Suspect S. aureus or S. pyogenes**
  - **Mild**
    - Dicloxacillin 250-500mg po QID
    - Cefadroxil 500mg po BID
    - Cephalexin 250-500mg po QID
  - **Moderate-severe**
    - Nafcillin or oxacillin 1-2g iv q4-6h
    - Cefazolin 1-2g iv q8h

### Treatment (cont.)
- **Documented streptococcal infection**
  - **Mild**
    - PenVK 500mg po QID or procaine PCN G 600,000 U IM q8-12h
  - **Moderate-severe**
    - Aqueous PCN G 1-2 MU iv q4-6h

### MRSA infection
- Vancomycin 1g iv q24h
- Linezolid 600mg po BID
- Synercid 7.5mg/kg q8-12h
- Daptomycin 4mg/kg iv q24h
Cellulitis (cont.)

Treatment (cont.)
• Gram-negative infection
  – Mild
    • Cefadroxil 500mg po TID
    • Cefuroxime 500mg po BiD
  – Moderate-severe
    • Aminoglycoside
    • Third generation cephalosporin (ceftriaxone, cefotaxime)
    • PCN allergy – use FQ (cipro, levofloxacin, gatifloxacin, or moxifloxacin)

Cellulitis (cont.)

Treatment
• Mixed aerobic infection
  – Aminoglycoside plus PCN G 1-2 MU or nafcillin 1-2g iv q4-6h
  – Ceftazidime and fluoroquinolones also effective

Cellulitis (cont.)

Treatment (cont.)
• Mixed aerobic/anaerobic infection (10-14d)
  – Mild
    • Augmentin 875mg po BID
    • FQ (levofloxacin 500-750mg po qd; ciprofloxacin 400mg po BID) plus clindamycin 300-600mg po TID or metronidazole 500mg po TID
  – Moderate-severe
    • Aminoglycoside plus clindamycin 600-800mg iv q8h or metronidazole 500mg iv q8h
    • Cefotaxim 1-2g iv q8h
    • Cefuroxime 1-2g iv q8h
    • Imipenem 500mg iv q6-8h
    • Piperacillin/tazobactam 4.5g iv q8h
Necrotizing SSTI’s

• Pathogenesis
  – Can occur anywhere, but most frequently in abdomen, perineum, and lower extremities
  – Predisposing factors common – diabetes, local trauma/infection, recent surgery
  – Necrotizing fasciitis – rare, severe infection of subcutaneous tissue; Type I and II
  – Clostridial myonecrosis (gas gangrene) – severe infection involving skeletal muscle

Necrotizing SSTI’s (cont.)

• Clinical Findings
  – Necrotizing fasciitis
    • Red, warm, shiny, tender, painful
    • Diffuse swelling = d-formation of fluid-filled blisters
    • High mortality (20-50%)
    • Type I – slower spread of infection, skin may be spared
    • Type II – rapidly extending necrosis of subcutaneous tissues and skin, gangrene, severe local pain, highly associated with early onset shock and organ failure
  – Clostridial myonecrosis
    • Gas production, muscle necrosis, rapid progression (often within a few hours)
    • May have mental confusion and tachycardia

Necrotizing SSTI’s (cont.)

• Etiology
  – Necrotizing fasciitis
    • Type I – mixture of anaerobes (Bacteroides, Peptostreptococcus) and facultative bacteria (streptococci, Enterobacteriaceae) – synergy
    • Type II – S. pyogenes (“flesh-eating bacteria”)
  – Clostridial myonecrosis
    • Clostridium perfringens
Necrotizing SSTI’s (cont.)

- Treatment
  - Immediate, aggressive surgical debridement
  - Same as severe mixed infection cellulitis with anaerobes
  - If Type II necrotizing fasciitis diagnosed \(\rightarrow\) penicillin + clindamycin
  - Clostridial myonecrosis \(\rightarrow\) penicillin + clindamycin

Bite Wounds

- Pathogenesis
  - Estimated that 50% of U.S. will be bitten during lifetime
  - Dog bites
    - Most common bite; usually < 20y.o. and male; 70% to extremities, occasionally facial (usually in young children)
  - Cat bites
    - Second most common; usually on upper extremities, mostly women, higher infection rates (30-50%) than dog bites
  - Human bites
    - Third most common; bites from teeth or blows to the mouth; more serious; higher rate of infection (50%); usually to the hand, clenched-fist very serious

Bite Wounds (cont.)

- Clinical Findings
  - Two groups
    - Present 8-12 hours after bite – general wound care, repair of tears, rabies and/or tetanus treatment
    - Present > 12 hours after bite – clinical signs of an established infection (pain, purulent discharge, swelling)
    - Human bite patients often complain of decreased range of motion
Bite Wounds (cont.)

• Etiology
  – Dog and cat bites
    • Pasteurella multocida
    • Aerobes – Streptococci, staphylococci, Moraxella, Neisseria
    • Anaerobes – Fusobacterium, Bacteroides, Porphyromonas, Prevotella
  – Human bites
    • Aerobes – S. aureus, streptococci, Corynebacterium spp., Eikenella corrodens
    • Anaerobes – B. fragilis, Peptostreptococcus spp.

Bite Wounds (cont.)

• Treatment
  – Dog and cat bites (10-14 days)
    • Irrigation w/ copious amounts of sterile NS
    • Immobilization and elevation of injured area
      – Infection w/in first 24h → P. multocida
        » Pen/VK 500mg po QID or amoxicillin 500mg po TID or if severe, PCN G 1.2 MU IV q4-6h
        » PCN allergy – tetracycline 500mg po QID
      – Infection 36-48h after bite → staph or strep
        » Dicloxacillin 250-500mg po TID or cefuroxime 500mg po BiD

Bite Wounds (cont.)

• Treatment
  – Dog and cat bites (cont.)
    • Prophylaxis for non-infected wounds is controversial
      – Need broad spectrum to cover normal flora of animal mouth and normal flora of human skin
      – Recommend short course therapy (3-5 days)
    • Tetanus toxoid to those requiring booster (>5-7 years since immunization)
    • Consider rabies with wild/stray animals
Bite Wounds (cont.)

• Treatment
  – Human bites
    • Aggressive irrigation, surgical debridement, immobilization
    • Primary closure usually not recommended
    • Tetanus toxoid may be necessary
    • Consider viral disease of biter (HIV?)
    • Prophylaxis of non-infected wound IS recommended (3-5 days)
      – Dicloxacillin 250-500mg po QID plus PenVK 250-500mg po QID

Bite Wounds (cont.)

• Treatment
  – Human bites (cont.) => infected wounds (10-14 days)
    • Pending culture results
      – Dicloxacillin 250-500mg po QID plus Augmentin 875/125mg po BID
      – PCN allergy – clindamycin plus fluoroquinolone or TMP-SMZ
      – If severe infection or clenched-fist injury => IV antibiotics

Burn Wounds

• Pathogenesis
  – Progressive tissue necrosis and limited defenses allow for pathogen invasion
  – Major disruption of homeostasis
  – Decreased body temperature due to heat loss may lead to progressive deterioration
  – Goal of early burn therapy is to ensure adequate delivery of oxygen and nutrients to the wound
  – Pts. with significant burns (>40%) are predisposed to infection due to nonspecific humoral and cellular immune suppression
Burn Wounds (cont.)

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

- Treatment
  - Surgical exploration and debridement may be needed based on severity and extent of burn
  - Topical – silver sulfadiazine, silver nitrate, sulfamylon
  - Oxacillin 500-1000mg po QID
  - Nafcillin 1g IV q4h
  - MRSA – vancomycin 1g IV q12h; Synercid, linezolid, and daptomycin are also options
  - Sepsis – vancomycin 1g IV q12h plus amikacin 10mg/kg LD, then 7.5mg/kg IV q12h plus piperacillin 4g IV q4h