Skin & Soft Tissue Infections (SSTIs)

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SSTIs Objectives
- To classify types of skin infections
- To present a case of cellulitis and discuss management
- To discuss differences in the management of community associated versus hospital associated SSTIs
- To present a case of decubitus ulcer and discuss management
- To describe management of animal bite wounds

Immune System

I. Innate Immunity
- epithelial cells, dendritic cells, macrophages, natural killer cells, neutrophils

Epithelium: first line of defense

Classification of SSTIs
- Simple uncomplicated (mostly Gram +)
  - Cellulitis
  - Impetigo
  - Erysipelas
  - Simple abscess
  - Furuncles (boils)
- Complicated:
  - Decubitus ulcer
  - Necrotising fasciitis
  - Cellulitis
  - Gangrene

Case of Cellulitis

Otherwise healthy 40 yr old man felt feverish and noted pain and redness on foot.

What diagnostic procedures and treatment are indicated?
Cellulitis

- Acute, spreading infectious process affecting epidermis and dermis
- Inflammation with little or no necrosis, edema
- Lymphatic involvement
- Fever, chills, leukocytosis
- Bacteremia up to 30% of cases
- Complications:
  - Abscess and osteomyelitis
  - S. aureus
  - Streptococcus pneumoniae (group A streptococcus)

Microbiology

- Majority of infections:
  - Staphylococcus aureus
  - Streptococci
- Considerations:
  - Methicillin resistant S. aureus (MRSA)
  - Vancomycin resistant enterococci (VRE)
  - Gram negatives: pseudomonas, E. coli
  - Anaerobes: Clostridium, Bacteroides, peptostreptococci

Predisposed to Cellulitis

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Bacterial Cause (most common)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liposuction</td>
<td>S. aureus, streptococcus</td>
</tr>
<tr>
<td>IV drug users</td>
<td>S. aureus, streptococcus, Gram -</td>
</tr>
<tr>
<td>Mastectomy</td>
<td>S. aureus, streptococcus</td>
</tr>
<tr>
<td>Body piercing</td>
<td>S. aureus, streptococcus</td>
</tr>
<tr>
<td>Insect bite</td>
<td>S. aureus, streptococcus</td>
</tr>
<tr>
<td>Animal bite</td>
<td>Pasteurella multocida (cat/dog)</td>
</tr>
<tr>
<td>Immunocompromised</td>
<td>S. aureus, streptococcus, enterococcus, Gram – (pseudomonas, E. coli)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>S. aureus, streptococcus, pseudomonas, anaerobes</td>
</tr>
</tbody>
</table>

Treatment of Cellulitis (community)

- Duration 7 to 10 days
- Penicillins:
  - Penicillin (group A streptococcus only): orally/IM
  - Nafcillin (MSSA or streptococcus)
  - Dicloxacillin orally
- Cephaloporins (1st generation):
  - Cefazolin IV
  - Cephalexin/cefprozil orally
- Macrolides:
  - Erythromycin/Azithromycin/Clarithromycin
  - Clindamycin
- Vancomycin IV: PCN allergic
- Linezolid IV/PO

Case of Cellulitis

Despite IV treatment with cefazolin, infection progressed over last 24 hr and patient remained febrile.

What considerations to treatment should be noted?
MRSA Cellulitis

Methicillin resistance: Penicillin binding protein (PBP-2A)

- Resistance to all beta-lactam and penicillin antibiotics

- Vancomycin
- Linezolid
- Clindamycin (confirm sensitivity) +/- Vancomycin
- Daptomycin
- Trimethoprin-sulfamethoxazole
- Synercid

Inducible clindamycin resistance

- Double-disk diffusion test (D test) demonstrating erythromycin disk (15 mg) induction of clindamycin resistance (2 mg);
- A blunting of the zone of inhibition around the clindamycin disk is produced that forms a D shape (arrow);
- If there is no distortion it suggests presence of msrA (efflux gene).

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In vitro iMLS

- MRSA susceptible to clindamycin and resistant to erythromycin
- Phenotype of inducible macrolide-lincosamide-streptogramin B resistance (iMLS)
- Inducible erythromycin ribosomal methylase (erm) genes, methylate 23S RNA
- Erythromycin and azithromycin: strong inducers
- Lincosamide (clindamycin) weak inducer
- High rate of mutation (constitutive resistance) selected during clindamycin therapy ($10^{-7}$ to $10^{-8}$)
- Second phenotype:
  - msrA: ATP-dependent efflux pump,
  - resistance only to macrolides not clindamycin

CA-MRSA in Minnesota

12 sentinel hospitals (6 urban & 6 rural)

*2004: 1946 cases of MRSA; CA-MRSA 465 (24%)
*CA-MRSA USA300 increasing and USA400 decreasing

2004: 42% of 1946 isolates testing completed as of May 2005
### USA300 vs. USA400

- **CA-MRSA USA400 (24% for MN in 2004)**
  - Staphylococcus enterotoxins B and C (SEB or SEC); +/- PV leukocidin
  - Staphylococcal cassette chromosome mec (SCCmec) type IV
  - Antibiotic susceptibility patterns may differ

- **CA-MRSA USA300: (43% for MN in 2004)**
  - Panton-Valentine (PV) leukocidin: tissue necrosis
  - SCCmeC IV: clindamycin/erythromycin; [mrrA (macrolide efflux pump)]
  - Negative for SEs: A thru D and TSST-1; other superantigens yet to be identified?

### Impetigo

- Superficial cellulitis
  - Group A streptococci
  - *S. aureus* 10% of patients
  - Small, fluid-filled vesicles, pus-filled blisters
  - Lesions dry to form golden-yellow crusts
  - Treatment:
    - Penicillin (drug of choice)
    - Benzathine penicillin G IM x 1
    - Penicillin VK PO
    - PCN-allergic: erythromycin PO x 7 to 10 days
    - Mupirocin: topical less effective than oral therapy

### Erysipelas

- Superficial cellulitis with extensive lymphatic involvement
  - *S. pyogenes* (group A streptococci)
  - 30% of pts. have had a streptococcal respiratory infection.
  - Treatment:
    - Penicillin
    - 1st gen. cephalosporin
    - macrolide

### Case of Nosocomial Cellulitis/Skin Ulcers

An 85 yr old female with dementia residing in a nursing home developed a pressure ulcer due to immobility and now complains of pain and is febrile.

What are the diagnostic and treatment considerations?

- **Stage 1**: Skin is intact but shows a persistent pink or red area
- **Stage 2**: Skin starts to breakdown and there is partial thickness skin loss.
- **Stage 3**: Skin has broken down & wound now extends through all layers.
- **Stage 4**: Full-thickness skin loss with extension beyond the deep fascia & involvement of muscle, underlying organs, bone, and tendon or joint space
Microbiology
Nosocomial Cellulitis/Skin Ulcers
- Polymicrobial:
  - 3 to 5 organisms per infection in hospitalized patients
  - Staphylococci most common, 2nd most common Streptococcus
  - Gram negative bacilli and/or anaerobes occur in approx. 50% of cases

Microbiology
Nosocomial Cellulitis/Skin Ulcers

<table>
<thead>
<tr>
<th>Gram Negative</th>
<th>Gram Positive</th>
<th>Anaerobes</th>
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<tbody>
<tr>
<td>Proteus spp.</td>
<td><em>S. aureus</em></td>
<td>Peptostreptococcus</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td><em>S. epidermidis</em></td>
<td><em>Clostridium</em> spp.</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td><em>Streptococci</em> spp.</td>
<td><em>Bacteroides</em> spp.</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td><em>Enterococci</em> spp.</td>
<td></td>
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<tr>
<td>Enterobacter spp.</td>
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Treatment
Nosocomial Cellulitis/Skin Ulcers
- **Empiric-Oral (mild to moderate)**
  - Amoxicillin/clavulanic acid
  - Dicloxacillin
  - TMP/SMX
  - Cephalexin
  - Clindamycin
  - Levofloxacin
  - Gatifloxacin
  - Moxifloxacin

  (if no clinical improvement in 48 to 72 hrs, IV abx)

Treatment
Nosocomial Cellulitis/Skin Ulcers
- **Empiric-Intravenous (severe/life threatening)**
  - Ampicillin/sulbactam + aminoglycoside
  - Piperacillin/tazobactam + aminoglycoside
  - Imipenem/cilastatin (meropenem) + aminoglycoside
  - Ampicillin + clindamycin + aminoglycoside
  - Levofloxacin or Gatifloxacin + aminoglycoside
  - (includes Pseudomonas coverage)

Special Considerations
- *Enterococcus* spp. (not common pathogen)
  - NO enterococcal coverage: clindamycin, cephalosporins, ticaricillin
  - Consider: penicillin, ampicillin, piperacillin, imipenem/cilastatin, vancomycin,
  - VRE: Synercid, linezolid, chloramphenicol, daptomycin
- *Pseudomonas aeruginosa*
  - Piperacillin, ceftazidime, imipenem/cilastatin, meropenem, erapenem, ciprofloxacin, levofloxacin, tobramycin
- MRSA
  - Vancomycin or linezolid or daptomycin or Synercid
Factors Affecting Abx Selection

- Vascular impairment - penetration of abx
- Impaired renal funct. - caution aminoglycosides
- Autonomic neuropathy/gastroparesis - decreased absorption of oral abx
- Antibiotic Resistance patterns
- Drug allergies - penicillin allergies

Infected Pressure Sores

- Prevention:
  - Single most important aspect
- Clean and debridement of wound
- Disinfection
- Topical Antibiotics

Bite Wounds

- 4 million people bitten by dogs annually.
- 40% of cat bites/scratches become infected
- Pasteurella multocida (most common)
- S. aureus, streptococcus
- Anaerobes: Bacteroides and Fusobacterium

Treatment:
- Penicillin
- Augmentin
- Tetracycline
- TMP/SMX
- Levofloxacin

SSTIs Conclusions

- Skin is the first barrier to infection (innate immunity)
- Acute cellulitis usually caused by S. aureus or streptococcus.
- Anti-staphylococcal (nafcillin/cefazolin/clindamycin) therapy should be used.
- Increasing risk for MRSA community-associated cellulitis
- Penicillin should be used if infection known to be streptococci.
- Modify therapy to broad-spectrum antibiotics for hospital associated SSTIs to include pseudomonas coverage.
- Cat/dog bite wounds mostly caused by P. multocida and DOC is penicillin (tetracycline/quinolone alternatives).