Necrotizing Fasciitis and Soft-Tissue Infections
Necrotizing Fasciitis

• Deep seated infection of subcutaneous tissues resulting in progressive destruction of fascia, muscle, and fat
  
  ▪ Type I
    - Mixed infection with aerobic and anaerobic bacteria
    - Most common in pts with DM and PVD, after surgical procedures
  
  ▪ Type II
    - Group A streptococcus (GAS, Streptococcus pyogenes)
    - Spontaneous gangrenous myositis considered separately

Stevens DL. Necrotizing infections of the skin and fascia. UpToDate® 2005.
Type I

- Caused by penetrating or blunt trauma and IVDA; common in DM, immunocompromised pts

- Predominant isolates: E. coli, Streptococci, Enterococci, S. aureus, Peptostreptococcus species, Bacteroides fragilis, and Clostridium species

- Average of 4.6 isolates per specimen

Type II

- “Streptococcal gangrene”, dramatic increase in 1990s
- Immunocompromised pts, penetrating or blunt trauma, IVDA, chickenpox, surgical procedures, childbirth
- Hematogenous translocation of GAS from pharyngitis or trauma
- Alternative hypothesis: GAS dormant in deep tissues and reactivated by trauma

Streptococcal Necrotizing Myositis

- “Spontaneous gangrenous myositis”, high mortality (80-100%)
- Fever, pain, board-like induration of affected muscle
- Most pts otherwise healthy, DM and HIV do not increase risk
- No gas on X-ray

Streptococcal Toxic Shock Syndrome

- Constitutional symptoms, bacteremia, hemolysis, hypotension, septic shock, ARDS, ARF, MOF, coma, death
- Entry thru skin, vagina, pharynx, or unknown source
- GAS virulence factor: antiphagocytic M protein
- High mortality (30-60%)

Pyomyositis

• Common in tropics; affects thigh, calf, and gluteals

• *S. aureus* predominant, but *Streptococcus*, *Yersinia*, *Klebsiella*, *Pasteurella*, *Enterobacter*, *Clostridium*, mycobacteria, and *Candida* have been reported

• Neutropenia or qualitative defects of neutrophil function predispose to pyomyositis

• Tx: antibiotics, percutaneous or open drainage

Clostridial Soft Tissue Infections

- Contamination → anaerobic cellulitis → myonecrosis
- Traumatic, recurrent, or spontaneous types
- Invasion of healthy muscle
- Virulence factors: $\alpha$-toxin and $\theta$-toxin
- Rapid advance to hypotenstion, ARF (RTN), sepsis, and MOF

Diagnosis

• ↑ WBC, ↑ CK, ↑ myoglobins

• X-ray, CT, or MRI helpful but should not delay prompt surgical exploration

• Clinical features allow distinction among necrotizing fasciitis, gas gangrene, pyomyositis, but surgical exploration often the final determinate

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## Differential Diagnosis

<table>
<thead>
<tr>
<th></th>
<th>Type I</th>
<th>Type II</th>
<th>Gas Gangrene</th>
<th>Pyomyositis</th>
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</thead>
<tbody>
<tr>
<td><strong>Agent</strong></td>
<td>Polymicrobial</td>
<td>GAS</td>
<td>Clostridium species</td>
<td>S. aureus</td>
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<tr>
<td><strong>Fever</strong></td>
<td>++</td>
<td>+++</td>
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<tr>
<td><strong>Pain</strong></td>
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<tr>
<td><strong>Systemic toxicity</strong></td>
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<td>+++</td>
<td>+++</td>
<td>+</td>
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<tr>
<td><strong>Tissue gas</strong></td>
<td>++</td>
<td>-</td>
<td>+++</td>
<td>-</td>
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<tr>
<td><strong>Predisposing factors</strong></td>
<td>DM, immune compromise</td>
<td>±</td>
<td>-</td>
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</tbody>
</table>

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Cultures

- Blood cultures positive in 20% of pts with Type I, and 60% of pts with type II necrotizing fasciitis
- Not completely reliable
- Skin or bullae aspiration may be positive but unreliable
- Awaiting results of cultures prior to surgical exploration and antibiotic coverage discouraged

Treatment

• Early and aggressive surgical exploration and debridement of all necrotic tissue

• Broad-spectrum antibiotic therapy

• Hemodynamic and respiratory support

• Best indication for surgical intervention is severe pain, fever, and toxicity, with or without radiographic findings

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Surgery

• Initial goals of surgery:
  1. establish diagnosis
  2. perform aggressive surgical debridement of all involved tissues

• Re-exploration should be performed in 24 hrs

• Repeat explorations and debridement may be necessary on daily basis
  - **Cervical necrotizing fasciitis** — expedited management essential due to proximity to vital structures
  - **Fournier's gangrene** — surgical emergency, may require cystostomy, colostomy, or orchiectomy
**Antibiotic Therapy**

- Broad-spectrum coverage

- Ampicillin or ampicillin-sulbactam (Unasyn) combined with clindamycin or metronidazole

- G(−) coverage necessary if pt recently hospitalized: ticarcillin-clavulanate (Timentin) or piperillin-tazobactam (Zosyn), or add fluoroquinolone, aminoglycoside, 3rd generation cephalosporin, or carbapenem

- GAS infection: clindamycin, penicillin ineffective due to inoculum effect

Intravenous Immune Globulin (IVIG)

- Neutralization of circulating clostridial toxins and streptococcal antigens
- Retrospective analysis and case reports show possible reduction in mortality
- May be effective adjunctive therapy for streptococcal toxic shock syndrome

Hyperbaric Oxygen

- Augments neutrophil bactericidal activity, kills strict anaerobes, inhibits growth of facultative anaerobes, limits clostridial exotoxin and spore production

- Improved outcomes in experimental models of gas gangrene and observational studies of necrotizing fasciitis

- High cost, barotrauma, tympanic membrane rupture


Mortality

- Type I: ~20%, type II: ~30-35%
  - Admission to surgery time > 24 hr independent predictor of mortality after controlling for age, sex, DM, and hypotension
  - Amputation does not affect mortality
- Cervical necrotizing fasciitis: ~20%
- Fournier's gangrene: ~20-40%

Conclusions

• Fulminant nature of soft-tissue infections require prompt recognition and treatment

• Early and frequent surgical debridement and wound treatment

• Antibiotic coverage tailored over time