Review on
Skin and Soft Tissue Infection

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Preface

- What are the common manifestations for cellulitis?
- What are the follow-up indicators for cellulitis?
  - •Associated findings: Bullae, Bruising, Crepitation, Intractable pain
  - •Ischemia: Distal Pulse (5P) , Compartment Pressure, Tissue Oxygen Saturation
  - •Demarcation
  - •Septic Manifestations

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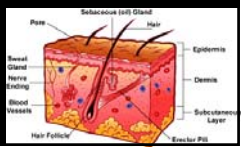
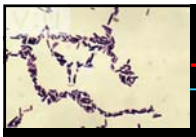
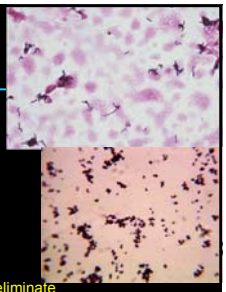
Skin - Structure and Function

- Large, complex organ that protects the body
- Surface area of 1.7 -1.9 m2
- Consists of:
  - epidermis
  - dermis
  - appendages (hair follicles, sweat glands)
- Acts as a physical barrier against microorganisms
- Protects from desiccation



Skin - Normal Flora





- Mostly gram-positive bacteria
  - staphylococci
  - micrococci
  - corynebacteria (diphtheroids)
  - *Propionibacterium acnes*
- Vigorous washing reduces but does not completely eliminate
- Sweat glands and hair follicles help to reestablish bacterial flora

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Skin - Definitions

- Vesicles:
  - small, fluid-filled lesions in the epidermis (eg. chicken pox)
- Bullae:
  - larger, fluid-filled lesions in the epidermis
- Macules:
  - flat, reddish lesion from inflammatory infiltrate
- Papules:
  - raised lesion which, when it contains pus, is called pustule

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Staphylococcus species

- **Staph**: grape-like clusters **coccus**: spherical
- Gram-positive bacteria - 0.5-1.5 μm in diameter
- Golden-yellow colonies on blood agar
- All are catalase positive
- All pathogenic *S. aureus* are coagulase positive

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Staphylococcus spp. - Classification

- *S. aureus*
- Coagulase negative staphylococci:
  - *S. epidermidis*
  - *S. saprophyticus*
  - Others

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Staphylococcus spp. - Virulence Factors

- Coagulase
- Toxins:
  - hemolysins
  - enterotoxins
  - pyrogenic toxins: A, B, C
- Exfoliation
- Leukocidin
- Protein A

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What is MRSA?

- It is *Staphylococcus aureus*, which is a particular bacteria that is the most common cause of skin infection in injectors as well as non-injectors
- Methicillin (like Keflex) Resistant *Staphylococcus aureus*
- MRSA is just *Staph aureus* that is resistant to the Keflex type antibiotics AND
- It has picked up some new genes that make it more aggressive in skin, and more likely to cause skin infection than "regular old" *Staph aureus* used to
- It now accounts for half the skin infections in injecting drug users
- It has to be treated with antibiotics other than Keflex or dicloxacillin

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Streptococcus species

- **Strepto**: chain-like **coccus**: spherical
- Gram-positive bacteria - 0.5-1.5 μm in diameter
- White to grey colonies of various sizes on blood agar
- Classified by ability to product hemolysins:
  - α-hemolytic: partial hemolysis of RBCs
    - viridans streptococci, *Streptococcus pneumoniae*
  - β-hemolytic: complete hemolysis of RBCs
    - *Streptococcus pyogenes*, *Streptococcus agalactiae*
  - γ-hemolytic: no hemolysis of RBCs
    - some *Streptococcus milleri*

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Streptococcus pyogenes

- Group-A streptococci (GAS) from the Lancefield classification
- Gram-positive bacteria in short chains, 0.5-1.0 μm in diameter
- Expresses β-hemolysis
- Does not produce catalase or coagulase

Anaerobes

- Bacteria which grow in the absence of oxygen
  - facultative (*S. aureus*, *E. coli*)
  - obligate (*Bacteroides fragilis*, *Fusobacterium* spp.)
- Commonly found as normal flora of the bowel and mouth
- Can infect necrotic tissues including skin

Anaerobes

- Gram-positive
  - Cocci:
    - *Peptostreptococcus* spp.
  - Bacilli (rods):
    - *Propionibacterium acnes, Clostridium perfringens, C. tetani, C. difficile*
    - *Actinomyces* spp.
- Gram-negative
  - Cocci:
    - *Veillonella* spp.
  - Bacilli:
- *Bacteroides fragilis*
    - *Fusobacterium* spp.

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Bacterial Diseases of the Skin

- Folliculitis: infection of hair follicle (*S. aureus*)
- Impetigo: vesicular, later crushed, superficial infection of the skin (*S. pyogenes, S. aureus*)
- Cellulitis: acute spreading infection of the skin extending to involve the subcutaneous tissues (*S. aureus, S. pyogenes,* anaerobes)
- Erysipelas: distinctive type of superficial cellulitis of the skin with prominent lymphatic involvement (*S. pyogenes*)

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Bacterial Diseases of the Skin

- Furuncle: deep inflammatory nodule usually developing from folliculitis (*S. aureus*)
- Carbuncle: more extensive than a furuncle with involvement of the subcutaneous fat (*S. aureus*)
- Staphylococcal Toxic Shock Syndrome: acute febrile illness with a generalized scariatiniform eruption (*S. aureus*)
- Scalded Skin Syndrome: widespread bullae and exfoliation from *S. aureus* strains producing an exfoliative exotoxin

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Cellulitis

- In cellulitis the skin is red, hot, and painful.
- Cellulitis can exist alone, with no pus, or it can surround an area of pus. Pus is commonly called “an abscess”.
- We have all had cellulitis. The smallest cellulitis is the redness around a zit. A large area of cellulitis can involve a whole area of the body, such as the face, an arm or a leg, etc.
- What’s happening in a cellulitis.

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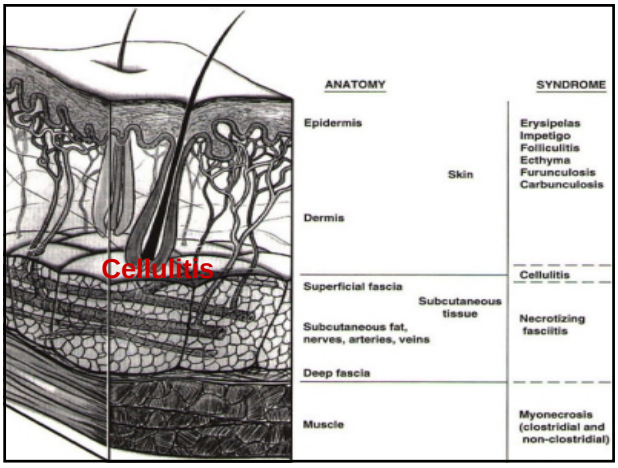

Cellulitis

Features:

Red

Swollen

Warm to touch

No areas of pus

Painful

Tender

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Cellulitis

Describe the features that make this cellulitis

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Treatment of Cellulitis

- Give the right antibiotic
- This is usually NOT Keflex anymore
- Over half of the cellulitis infections are now resistant to treatment with Keflex and similar antibiotics
- Current antibiotics of choice are clindamycin, doxycycline, or trimethoprim-sulfa ("Bactrim", "Septra")
- Severe cellulitis should probably be treated initially with IV antibiotics, especially if the person has a high fever and appears ill from the infection

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Necrotizing Cellulitis

- Limited to skin and SQ, polymicrobial
- *C. perfringes* most common
- Pain and erythema at infection site
- Ecchymotic or frankly necrotic center
- Systemic symptoms may be mild or absent
- Debridement and broad spectrum antibiotics

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Erysipelas

- Superficial cellulits involving lymphatics
- Primarily GAS
- Abrupt onset, high fevers, chills, malaise
- Erythema with burning sensation, continues red, shiny hot plaque forms
  - *St. Anthony's fire*
- Toxic striations and local lymphadenopathy
- PenG in non DM
- Nafcillin, oxacillin, rocephin, augmentin in DM
- Admission to hospital

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Cutaneous Abscesses

Tender, swollen, erythematous, fluctuant nodule

Scalp, trunk and extremity *staph*

Oral and nasal mucosa *strep*

Intertriginous/perineal gram negative aerobes (*E.coli*, *P. mirabilis*, *Klebsiella sp*)

Axilla *P. mirabilis*

Perirectal/genital anaerobic and aerobic (*bacteroides sp*)

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Cutaneous Abscesses, Cont

Foreign bodies *S. aureus*

Cat bites *Pasturella multicida, S. aureus, S. viridans, Eikenella corrodens*

Human bites *P. multicida, Bacteroides fragilis* and *Corynebacterium jeikeium, staph* and *strep*

IV drugs mixed with anaerobic prevailing

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Diagnosis of Cutaneous Abscess

- No need for further eval if simple, healthy pt
- Fever, tachycardia suggests systemic
- DM, alcoholism, immunocompromised
- CBC and ESR to evaluate for systemic
- Immunocompromised demonstrating systemic infections need blood cultures
- Foreign bodies need plain films +/- US

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Treatment of Cutaneous Abscesses

- Consent obtained, complications explained
- If pus, I & D
- If no pus, warm compresses and antibiotics
- Regional or field blocks, some may require systemic sedation or OR
- Area prepped and draped in sterile fashion
- No. 11 or 15 scalpel, hemostats for loculated areas, irrigated and packed with gauze tape

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Treatment of Cutaneous Abscesses, Cont

- Warm compresses and soaking TID
- F/U 2-3 days, replace packing if needed
- Use of antibiotics controversial
- DM, alcoholics, immunocompromised, pt with systemic symptoms should receive antibiotics
- Involving hands or face, more aggressive
- Antibiotic aimed at pathogen/location
- Duration 5-7 days
- Be aware of bacterial endocarditis

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Abscess

- When the tissue in the area of cellulitis turns to pus under the surface of the skin, the collection of pus is termed an "abscess"
- The pus in the abscess consists of dead, liquified tissue, billions of white blood cells (the infection fighting cells) and, often, the black tar heroin
- The most common bacteria in the abscess is "staph", or *Staphylococcus aureus* (aureus means golden, which is the color of the colonies of this bacteria when it is grown on a Petri dish in the lab)
- There are many other bacteria that can cause abscesses

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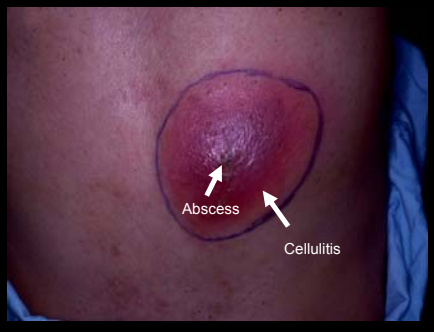
Abscess



Features:

Cellulitis present

Swollen

Soft center, feels like fluid underneath

Painful

Tender

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Abscess

Large abscess

Possibly up to a cup of pus when opened

Crinkling of the skin suggests the swelling is going down

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Abscess

Large abscess about to be incised (cut open) and drained of pus. This is too large to drain in the office.

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Treatment of Abscesses

- Abscesses should be drained
- This can be done at home with a sterilized single edged razor blade, or an Exacto knife
- Sterilize by heating in a flame, allow to cool
- Clean the skin off with alcohol or iodine before opening the abscess
- If the abscess has a lot of cellulitis around it, an antibiotic is probably needed

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"Sterile" Cellulitis and Abscesses

- If you inject sterile (no bacteria in it) tar heroin under the skin the body will react to it in the same way as it does to bacteria
- The cellulitis may not get better with antibiotics
- The abscess forms around the tar heroin that is sitting in a glob under the skin

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Hidradenitis Suppurativa

- Recurrent chronic infection of follicle within apocrine gland
- Occur in axilla, groin and perianal regions
- Higher in women and AA
- Usually staph, can be strep
- I & D, surgeon referral, antibiotics if areas of cellulitis or systemic symptoms

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Infected Sebaceous Cyst

- Erythematous, tender nodule, often fluctuant
- I & D
- Capsule must be removed at follow up visit

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Pilonidal Abscess

- Superior gluteal fold
- Staph most common
- I & D, removing all hair and debris, packed with iodoform gauze, repacking 2 -3 days
- Surgical referral

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Staphylococcal Soft Tissue Abscesses

Folliculitis = inflammation of hair follicle

Tx: warm soaks

Furuncle (boil) = abscess of hair follicle

Tx: warm compresses to promote drainage

Carbuncle = coalescing furuncles, large infection

Tx: surgical excision

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Sporotrichosis

- Mycotic infection cause by *Sporothrix schenkii*
- Commonly found on plants, vegetation and soil
- Incubation period 3 weeks, 3 types of reactions, painless nodule or papule, then SQ nodules
- Fungal culture, tissue biopsy diagnostic
- Increased WBC, eosinophils, ESR
- Itraconazole 100 - 200mg QD for 3 – 6 months

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Soft Tissue Infections

- Necrotizing fasciitis
  - "flesh-eating disease"
  - sever infection involving the subcutaneous soft tissue, particularly the superficial and deep fascia
  - predisposing conditions: diabetes, abdominal surgery, perineal infection, trauma
  - organisms: *S. pyogenes*, *C. perfringens*, mixed aerobic and anaerobic bacteria
  - treatment surgical debridement, antibiotics, ± immunoglobulins

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Soft Tissue Infections

- Myositis
  - infection of skeletal muscle (rare)
  - *S. aureus, S. pyogenes* (rare), mixed organism
- Gas gangrene
  - rapidly progressive, life-threatening, toxemic infection of skeletal muscle due to clostridia

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Necrotizing Soft Tissue Infections

- Differentiated by primarily by depth
- Polymicrobial, mixed aerobic and anaerobic
- Early recognition and aggressive treatment important due to rapid progression and high mortality

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Necrotizing Fasciitis
Epidemiology

- 27/10,000 hospital admits
- Necrosis involving SQ and fascia (no muscle)
- "flesh-eating bacteria"
- LE, UE, perineum, trunk, head, neck and buttocks in decreasing order of incidence
- Overall mortality 25 – 50%

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Necrotizing Fasciitis
Pathophysiology

- Mixed-organism most common
- If single organism, typically group A strep
- Symbiotic relationship between bacteria
- Insults such as IV injections, surgical incisions, abscess, insect bites and ulcers
- DM, PVD, smoking, IV drugs are risk factors

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Necrotizing Fasciitis
Clinical Features

- Pain out of proportion to physical exam
- Skin erythematous and edematous
- Discoloration, vesicles, and crepitus late
- Low grade fever, tachycardia are common
- Early, sensorium typically clear

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Necrotizing Fasciitis
Diagnosis

- CBC with diff, chemistry with LFT's, ABG, coags, serum lactate, blood cultures, tissue cultures
- Tissue biopsy down to deep fascial plane
- The "finger test": local anesthesia, 2-cm incision into suspected area (deep fascial plane), lack of bleeding and foul smelling cloudy fluid suggestive, place finger in incision, just superior to deep fascia and push forward, if finger dissects ST away from fascia without difficulty

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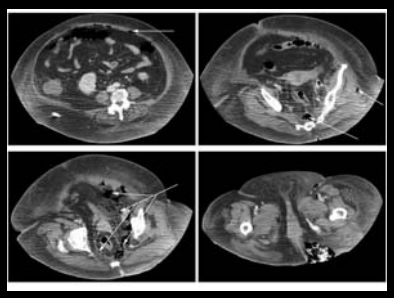
Necrotizing Fasciitis
Diagnosis



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Necrotizing Fasciitis
Treatment

- Aggressive fluid and resuscitation
- Avoidance of vasopressors
- Antibiotics similar to nonclostridial myonecrosis: empiric imipenem, meropemen or vancomycin, in PCN allergic clindamycin and FQ
- Surgical debridement mainstay
- HBO

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Necrotizing Fasciitis
Group A Streptococcus (GAS)

- Presentation, eval and treatment similar to polymicrobial
- Concomitant varicella infection especially in children, NSAIDs increase risk
- Usually no gas formation in soft tissue
- More rapid progression to bacteremia and TSS
- Broad spectrum antibiotics
- Clindamycin synergistic effect with PCN

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Necrotizing Fasciitis

- When the bacteria in a cellulitis or abscess start spreading quickly between the fat layer and the muscle underneath it is termed necrotizing fasciitis
- Necrotizing means turning living flesh to dead flesh
- Fasciitis means the infection is spreading along the space between the fat and the muscle underneath
- The infection cuts off the blood supply to the tissue above it and the tissue dies
- The bacteria also enter the bloodstream and cause severe systemic illness called “sepsis”

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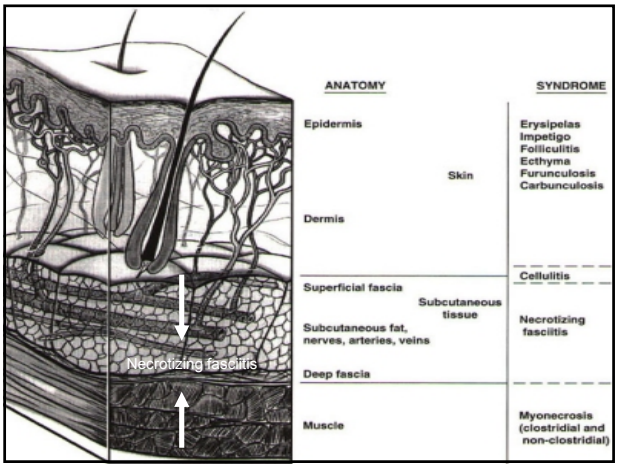

Indications of Necrotizing Fasciitis

- If the area of redness is spreading rapidly (this means about ½ inch or more per hour) this may be “nec fasc”
- If the area is extremely painful
- If the person shows signs of bacteria getting into the bloodstream (fever, change in mental function such as delirium, profound weakness)
- Draw a line around the red area with a pen, then watch for spreading beyond the line
- If spreading ½ inch or more per hour, go to a hospital

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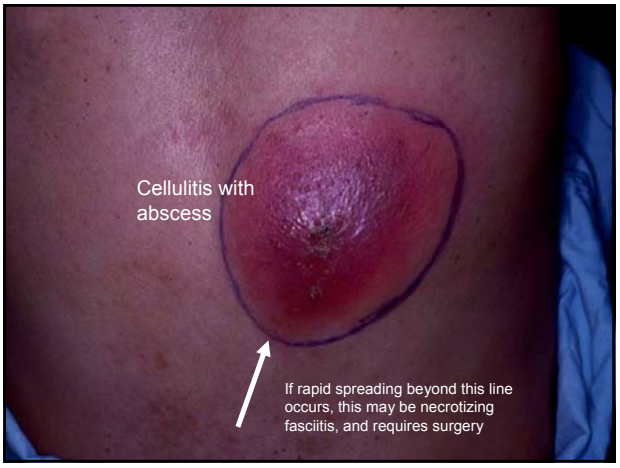

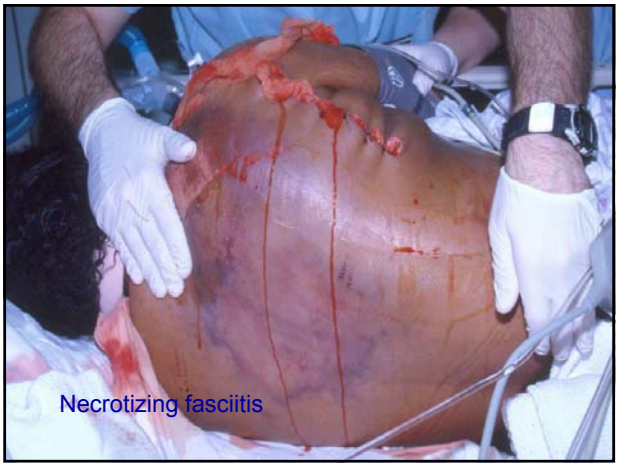

Treatment of Necrotizing Fasciitis

- Cut all the dead tissue out, and keep cutting until only living tissue is left
- Go back and do the same thing every few hours, as often as necessary, until the infection stops spreading
- Antibiotics help, but they will NOT cure the infection
- Without appropriate, drastic surgery the person will die
- The open muscle is then treated like a burn, with skin grafts

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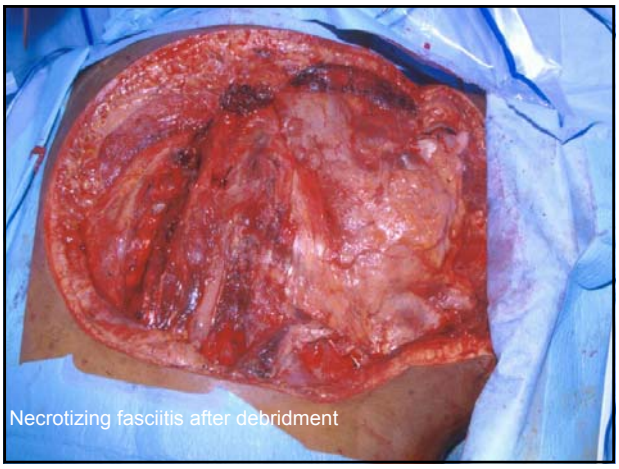

Necrotizing fasciitis after debridment

Danger Signs for "Nec Fasc"

- Very painful
- Spreading rapidly (1/2 to 1 inch per hour)
- Systemic toxicity
  - Fever
  - Chills, sweats
  - Profound weakness
  - Altered mental status
  - Low blood pressure

Person *must* go to hospital immediately or die!

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Streptococcal Myositis

- Rare form of invasive group A *Streptococcus*
- No gas production, very virulent
- High rate of bacteremia and subsequent TSS
- Mortality 80 – 100 %

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Gas Gangrene (Clostridium Myonecrosis)

- Rapidly progressive and limb/life threatening
- Spore-forming *Clostridial* sp
- Deepest necrotizing soft tissue infection
- Hallmarks are severe myonecrosis with gas production and sepsis

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Gas Gangrene (Clostridial Myonecrosis) Epidemiology

- 1,000 cases per year in US
- Ubiquitous organisms
- 7 species, *C.perfringes* 80-95%
- Gram +, spore forming anaerobic bacilli
- Found in soil, GI and female GU

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Gas Gangrene (Clostridial Myonecrosis) Pathophysiology

- Produce over ten exotoxins
- Exotoxin(α toxin) direct cardiodepressant, secondarily effects tissue breakdown
- Mechanisms of infection are direct innoculation (open wound), hematogenous spread

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Gas Gangrene (Clostridial Myonecrosis) Clinical Features

- Incubation < 3 days
- Pain out of proportion to physical findings
- "heaviness" of affected part
- Brawny edema and crepitance (later findings)
- Bronze/brownish with malodorous serosanguineous d/c, bullae may be present
- Low grade fever, tachycardia
- Confusion, irritability or sensorium changes

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Gas Gangrene (Clostridial Myonecrosis) Clinical Features Cont

- Labs: metabolic acidosis, leukocytosis, anemia, thrombocytopenia, coagulopathy, myoglobinuria, myoglobinemia, liver/kidney dysfunction
- GS: pleomorphic gram-positive bacilli with or without spores
- Radiologic studies may demonstrate gas

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Gas Gangrene (Clostridial Myonecrosis) Treatment

1) Resuscitation: crystalloid, plasma, packed cells

2) Antibiotics: PCN G (24 m units IV divided) plus clindamycin (900 mg IV q8h), ceftriaxone and erythromycin alternatives

   Mixed infections require aminoglycosides, PCNase resistant PCN's or vancomycin. Tetanus as indicated.

3) Surgery: debridement is mainstay

4) Hyberbaric oxygen (HBO): after debridement

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Gas Gangrene (Nonclostridial Myonecrosis)

- Mixed infections involving aerobic and anaerobic
- Presentation, eval and tx similar to *Clostridial* sp
- Pain not as pronounced, delay in presentation
- Broad-spectrum coverage: unasyn, zosyn, timentin, meropenem or imipenem
- Vanc, FQ and clindamycin in PCN allergic
- Early debridement and HBO

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Bone Infections

- Septic arthritis
  - infection of joint spaces
  - hematogenous or contiguous
  - *S. aureus, Streptococcus* spp., Gram-negative bacilli
- Osteomyelitis
  - infection of the bone
  - hematogenous or contiguous
  - *S. aureus, S. pyogenes, H. influenzae*, Gram-negative bacilli

Diabetic Foot Infection

- Cellulitis>Deep soft tissue infection>Osteomyelitis
- Risk factors:
  - vascular disease (macro and micro)
  - peripheral neuropathy
  - poor foot care

Diabetic Foot Infection

- Organisms:
  - skin organisms: *S. aureus*, β-hemolytic strep, diphtheroids
  - Gram-negative bacilli (*E. coli, K. pneumoniae, Pseudomonas* spp.)
  - Anaerobes

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Preventing Skin/Soft Tissue Infection

- Clean injection site (injection forces skin bacteria under the skin where they can cause infection)
  - Alcohol, hand alcohol gel, high octane booze
  - Dish soap or other non-irritating soap
- Clean syringe and needle
- Clean drug (the longer you heat it the less likely that bacteria will survive)

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Quiz

1. Gas Gangrene may present as:
   A. Pain out of proportion and heaviness
   B. Crepitance
   C. Bronze/brownish edema with malodorous discharge
   D. Confusion
   E. All of the above

2. Treatment of necrotizing fasciitis includes all the following except:
   A. Aggressive fluids and resuscitation
   B. Empiric antibiotics
   C. Vasopressors
   D. Surgical debridement
   E. HBO

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Quiz

3. T/F In Group A Strep Necrotizing Fasciitis, clindamycin has a synergistic effect with PCN

4. T/F Cutaneous abscess of scalp, trunk and extremity are usually Strep sp.

5. T/F Sporotrichosis incubation 3 days, treatment 3 weeks

1. E, 2. C, 3. T, 4. F staph, 5. F 3 weeks, 3 – 6 months

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