جامعة الملك سعود
King Saud University
1957

Laboratory and Clinical Aspects of Skin and Soft-Tissue Infections

IMPETIGO, ABSCESSES, CELLULITIS, ERYSIPELAS AND NECROTIZING FASCIITIS

Objectives

- Describe the anatomical structure of skin and soft tissues.
- Differentiate the various types of skin and soft tissue infections and their clinical presentation.
- Name bacteria commonly involved in skin and soft tissue infections
- Describe the pathogenesis of various types of skin and soft tissue infections
- Recognize specimens that are acceptable for different types of skin and soft tissue infections
- Describe the microscopic features and colony morphology of *Staphylococcus aureus* and *group A Streptococcus* and how to differentiate them from other bacteria
- Discuss non-microbiological investigations
- Describe the major approaches to treat of skin and soft tissue infections either medical or surgical.

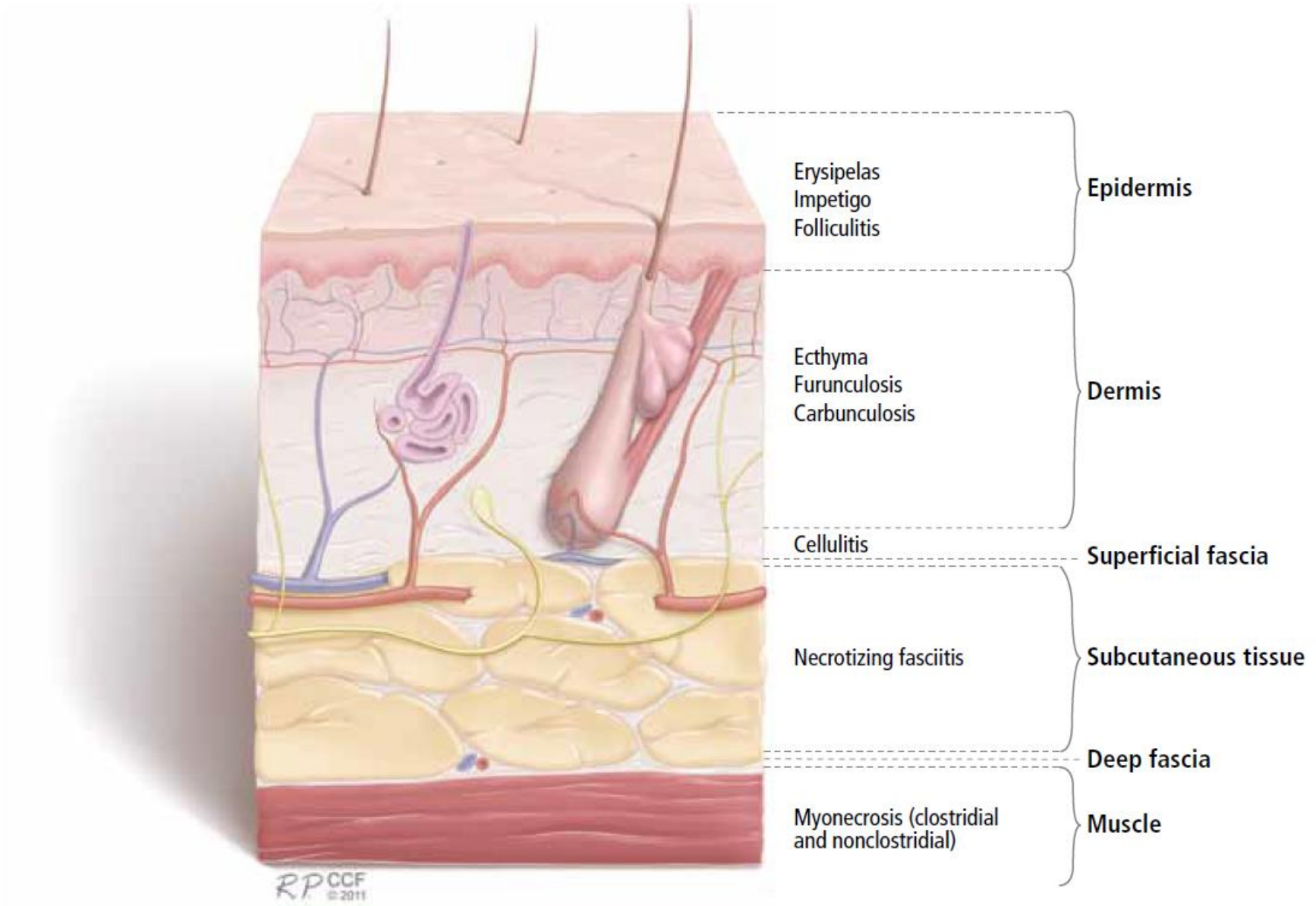
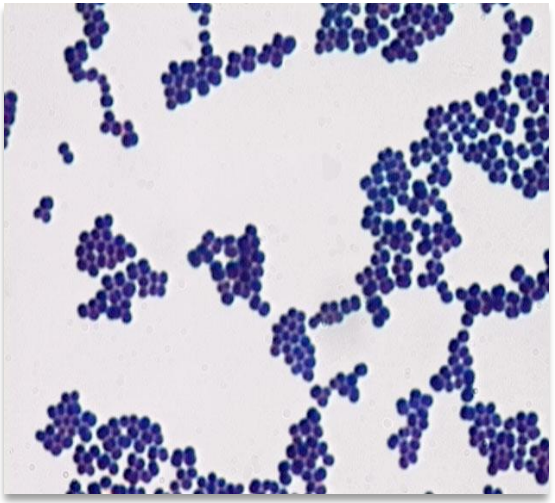


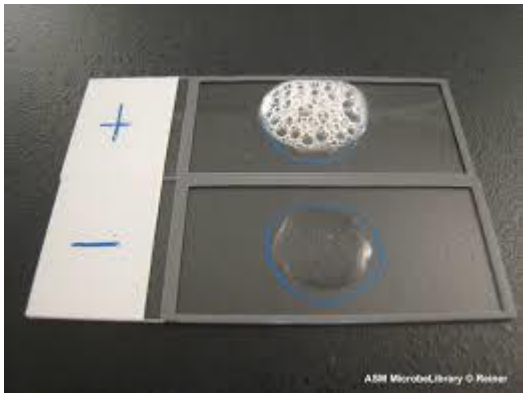
FIGURE 1. Depth of involvement in skin and soft-tissue infections.

Introduction

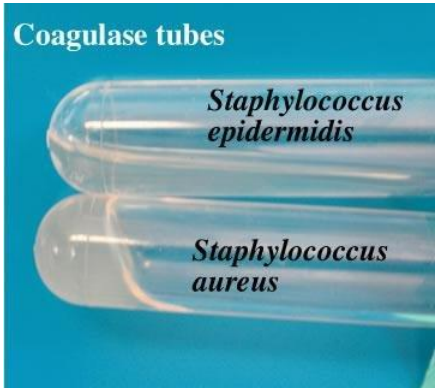
- Common
- Can be mild to moderate or sever muscle or bone and lungs or heart valves infection .
- ***Staphylococcus aureus*** **and** ***Streptococcus*** are the most cause common
- **Emerging antibiotic resistance among**
  - ***Staphylococcus aureus (methicillin resistance)***
  - ***Streptococcus pyogenes*** **(erythromycin resistance)**



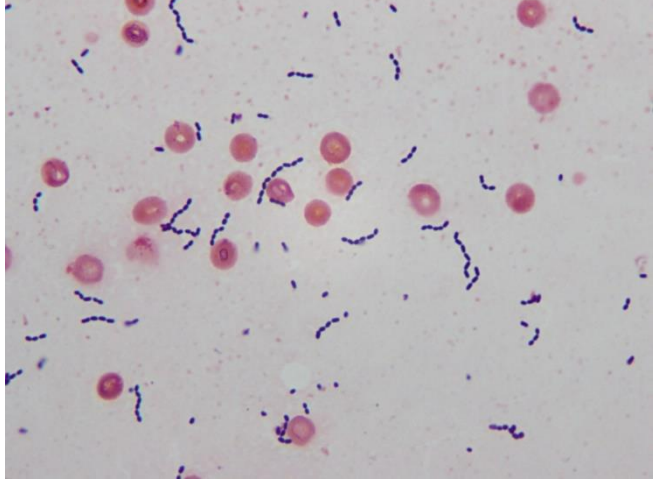
Gram positive cocci in clusters



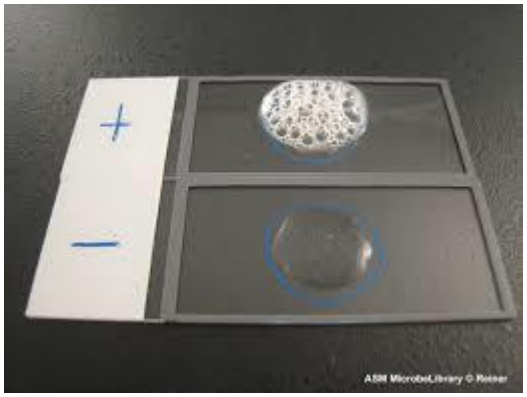
Catalase positive



Coagulase positive



Gram positive cocci in chain



Catalase negative

Beta hemolytic
Bacitracin sensitive

Key to developing an adequate differential diagnosis requires

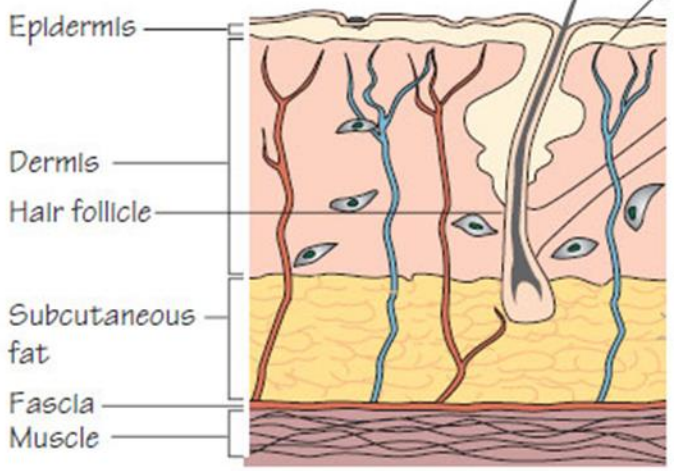
- History
  - Patient's immune status, the geographical locale, travel history, recent trauma or surgery, previous antimicrobial therapy, lifestyle, and animal exposure or bites
- Physical examination
  - To determine the severity of infection
- Investigation
  - CBCs, Chemistry
  - Swab, biopsy or aspiration
  - Radiographic procedures (X-rays, CT, MRI)
    - Level of infection and the presence of gas or abscess.
- Diagnostic and therapeutic
  - Surgical exploration or debridement
  - Antibiotics treatment

VIRAL PATHOGENS

- Herpes simplex
- Papillomavirus
- Molluscum
- Orf
- Varicella

FUNGAL PATHOGENS

- *Epidermophyton*
- *Microsporum*
- *Trichophyton*
- *Candida*
- *Malassezia furfur*



Folliculitis (*S. aureus*)

Staphylococcal scalded skin syndrome

Impetigo (*S. aureus, S. pyogenes*)

Erysipelas (*S. pyogenes*)

Cellulitis (*S. pyogenes*)

Necrotizing fasciitis (*S. pyogenes* or mixed anaerobic and aerobic organisms)

TOXIN MEDIATED

S. aureus
- Scalded skin
- Toxic shock

S. pyogenes
- Scarlet fever

Bacteria	Infection/Syndrome
S. aureus	Impetigo, furunculosis, boils, toxic epidermal necrolysis, acute paronychia
S. pyogenes	Cellulitis, erysipelas, impetigo
C. diphtheriae	Cutaneous diphtheria
M. tuberculosis	Lupus vulgaris
M. marinum	Chronic ulcerative disease
M. ulcerans	Destructive ulcers (Buruli ulcer)
C. minutissimum	Erythrasma
Pseudomonas aeruginosa	Colonization of burns
Erysipelothrix rhusiopathiae	Erysipeloid

IMPETIGO~(Pyoderma)

- A common skin infection
- Children 2–5 Yr in tropical or subtropical regions
- Nearly always caused by **β~hemolytic streptococci (GAS)**
- **In some cases β~hemolytic streptococci (GAS) and *S. aureus.***
- Rarely by *S. aureus only*
- Nonbullous (Streptococcus) or Bullous (*S. aureus)*
- Consists of discrete purulent lesions
- Exposed areas of the body(face and extremities)
- Skin colonization~ Inoculation by abrasions, minor trauma, or insect bites
- Systemic symptoms are usually absent.
- **Poststreptococcal glomerulonephritis.**
  - **(anti–DNAse B, ASO)**
- **Treatment**
  - **Cefazolin, Cloxacillin , or erythromycin**
  - **Mupirocin**

- **ABSCESSES, CELLULITIS, AND ERYSIPELAS**
  - ***Cutaneous abscesses.***
    - Collections of pus within the dermis and deeper skin tissues.
    - Painful, tender, and fluctuant
    - Typically polymicrobial, ***S. aureus*** alone in ~ 25 %
    - Do Gram stain, culture, and systemic antibiotics
      - Multiple lesions, cutaneous gangrene, severely impaired host defenses, extensive surrounding cellulitis or high fever.
    - Incision and evacuation of the pus

- ***Furuncles and carbuncles.***
  - **Furuncles** (or "boils") are infections of the hair follicle (folliculitis), usually caused by *S. aureus,* in which suppuration extends through the dermis into the subcutaneous tissue
  - **Carbuncle**- extension to involve several adjacent follicles with coalescent inflammatory mass - back of the neck especially in diabetics
  - Larger furuncles and all carbuncles require incision and drainage.
  - Systemic antibiotics are usually unnecessary

Outbreaks of furunculosis caused by MSSA, and MRSA,

- Families~prisons~sports teams
- Inadequate personal hygiene
- Repeated attacks of furunculosis
- Presence of *S. aureus in the* anterior narse~ 20~40%
- Mupirocin ointment~ eradicate staphylococcal carriage nasal colonization

Erysipelas and Cellulitis.

- Diffuse spreading skin infections, excluding infections associated with underlying suppurative foci
- Most of the infections arise from streptococci, often group A, but also from other groups, such as B, C, or G.
- **Erysipelas**
  - Affects the upper dermis (raised–clear line of demarcation)
  - Red, tender, painful plaque
  - Infants, young children– and older adults
  - β–hemolytic streptococci (group A or ***S. pyogenes***)
  - Penicillin–IV or oral.

- **Cellulitis**
- Acute spreading infection involves the deeper dermis and subcutaneous tissues.
  - **β-hemolytic streptococci**, Group A streptococci, and group B streptococci-diabetics
  - ***S. aureus*** : commonly causes cellulitis- penetrating trauma.
  - ***Haemophilus influenzae*** periorbital cellulitis in children
  - Risk factors ; Obesity, venous insufficiency, lymphatic obstruction (operations), preexisting skin infections- ulceration, or eczema,
  - CA-MRSA
    - Carry Panton-Valentine leukocidin gene
    - More sensitive to antibiotics
    - Can lead to sever skin and soft tissue infection or septic shock

Diagnosis and Treatment

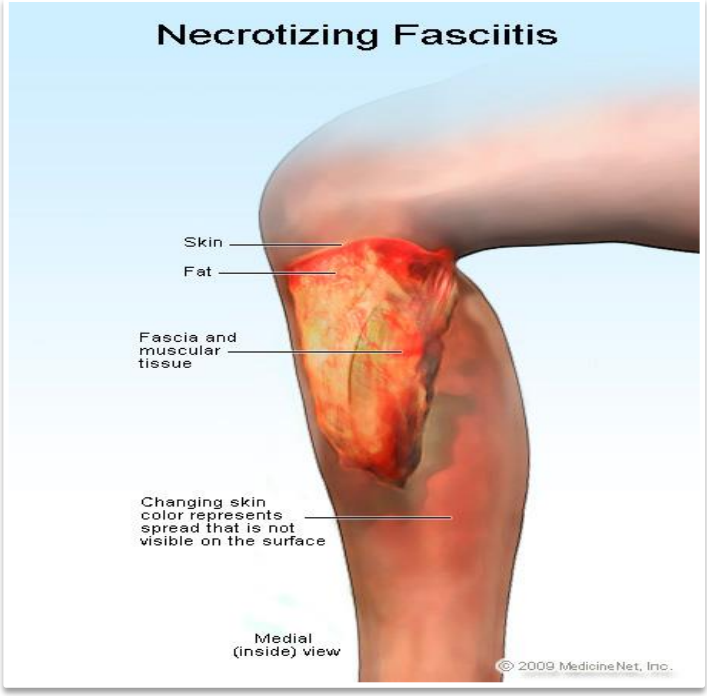
- Clinical diagnosis Symptoms and Signs
- High WBCs, blood culture rarely needed
- Aspiration and biopsy might be needed in diabetes mellitus, malignancy, animal bites, neutropenia (*Pseudomonas aeruginosa),* immunodeficiency, obesity and renal failure
- Observe for progression to sever infection(increased in size with systemic manifestation ie . fever, leukocytosis)
- Treatment: cover Streptococcus and Staphylococcus
  - Penicillin, cloxacillin, cefazolin(cephalexin),clindamycin
  - Vancomycin or linazolid in case of MRSA
  - Clindamycin, TMP-SMZ for **CaMRSA**

Necrotizing fasciitis

Flesh-eating disease

Introduction

- It is a rare deep skin and subcutaneous tissues infection
- It can be monomicrobial (Type II) or (polymicrobial Type I) infection
- Most common in the arms, legs, and abdominal wall and is fatal in 30%-40% of cases.



Introduction

- Monomicrobial
  - Group A streptococcus (*Streptococcus pyogenes*)
  - *Staphylococcus aureus or* CA-MRSA
  - *Vibrio vulnificus* (liver function)
  - *Clostridium perfringens* (gas in tissues) (Type III)
- Polymicrobial
  - Caused by aerobic and anaerobic bacteria
  - E.g. Fournier's gangrene (perineum and genital area)
  - *Bacteroides fragilis*
  - *Gram-negative bacteria* (synergy).
    - *E. coli*, *Klebsiella*, *Pseudomonas*
  - *Stretptococcus* (other than group A)
  - Uncommonly fungi

Risk factors

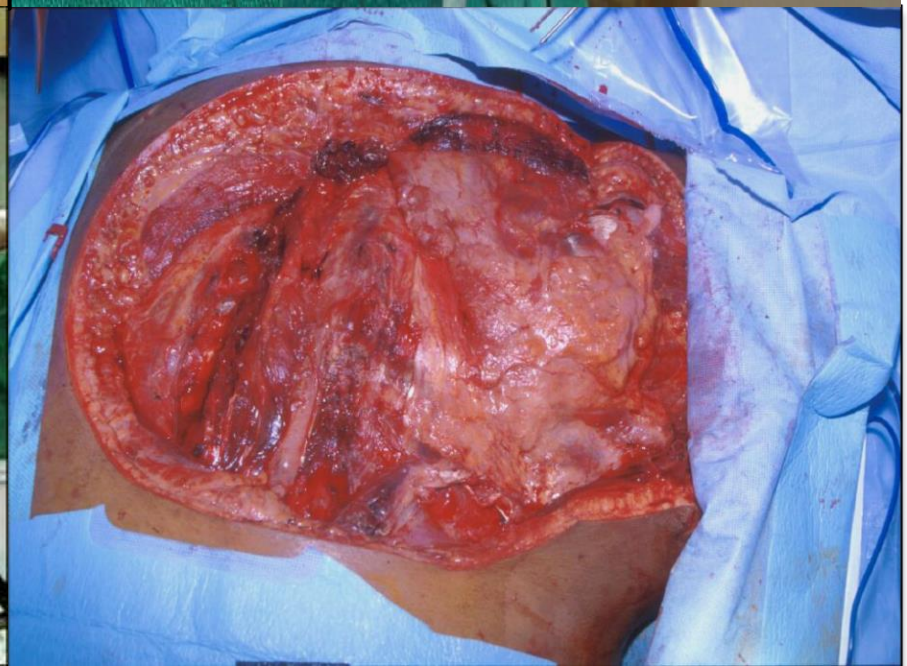
- Immune-suppression
- Chronic diseases: (diabetes, liver and kidney diseases, malignancy
- Trauma:(laceration, cut, abrasion, contusion, burn, bite, subcutaneous injection, operative incision)
- Recent viral infection rash (chickenpox)
- Steroids
- Alcoholism
- Malnutrition
- Idiopathic

Pathophysiology

- Destruction of skin and muscle by releasing toxins
  - Streptococcal pyrogenic exotoxin
  - Superantigen
    - Non-specific activation of T-cells
    - Overproduction of cytokines
    - Severe systemic illness (Toxic shock syndrome)

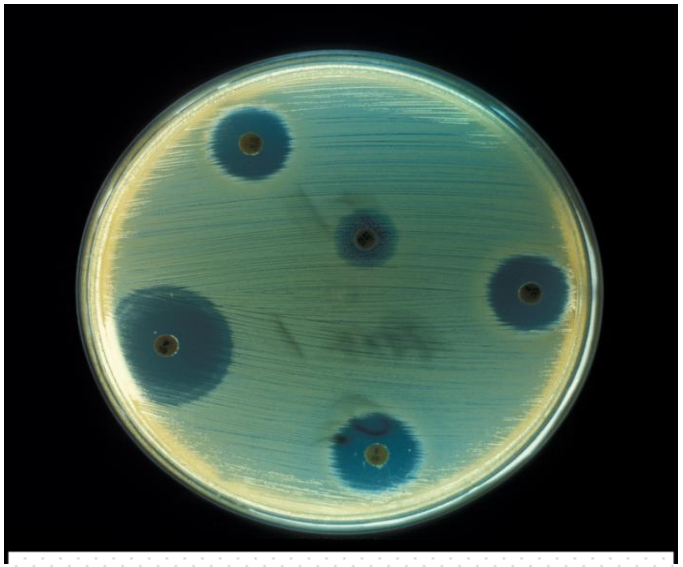
Signs and symptoms

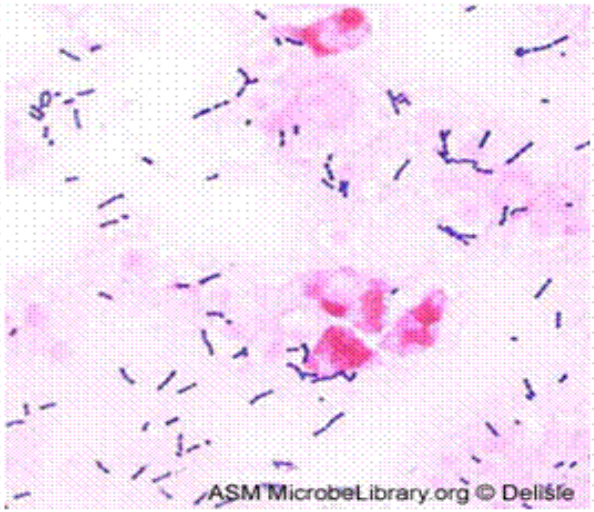
- Rapid progression of sever pain with fever , chills (typical)
- Swelling , redness, hotness, blister, gas formation, gangrene and necrosis
- Blisters with subsequent necrosis , necrotic eschars
- Diarrhea and vomiting (very ill)
- Shock organ failure
- Mortality as high as 73 % if untreated



Diagnosis

- A delay in diagnosis is associated with a grave prognosis and increased mortality
- Clinical~high index of suspicion
- Blood tests
  - CBC~WBC , differential , ESR
  - BUN (blood urea nitrogen)
- Surgery debridement~ amputation
- Radiographic studies
  - X~rays : subcutaneous gases
  - Doppler CT or MRI
- Microbiology
  - Culture &Gram's stain
    - (blood, tissue, pus aspirate)
  - Susceptibility tests





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Treatment

- If clinically suspected patient needs to be hospitalized OR require admission to ICU
- Start intravenous antibiotics immediately
- Antibiotic selection based on bacteria suspected
- broad spectrum antibiotic combinations against
  - methicillin-resistant *Staphylococcus aureus* (MRSA)
  - anaerobic bacteria
  - Gram-negative and gram-positive bacilli
- **Surgeon consultation**
  - Extensive Debridement of necrotic tissue and collection of tissue samples
  - Can reduce morbidity and mortality

Treatment

- Antibiotics combinations
  - Penicillin-clindamycin-gentamicin
  - Ampicillin/sulbactam
  - Cefazolin plus metronidazol
  - Piperacillin/tazobactam
  - *Clostridium perfringens* - penicillin G
- Hyperbaric oxygen therapy (HBO) treatment

Pyomyositis

- Acute bacterial infection of skeletal muscle, usually caused by *Staphylococcus aureus*
- No predisposing penetrating wound, vascular insufficiency, or contiguous infection
- Most cases occur in the tropics
- 60% of cases outside of tropics have predisposing RF: DM, EtOH liver disease, steroid rx, HIV, hematologic malignancy

Pyomyositis

- Hx of blunt trauma or vigorous exercise (50%), then period of swelling without pain. 10-21 days later, pain, tenderness, swelling and fever, Pus can be aspirated from muscle. 3rd stage: sepsis, later metastatic abscesses if untreated
- Dx: X-ray, US, MRI or CT
- Rx: surgical drainage +abx

Other Specific Skin Infections

Epidemiology	Common Pathgen(s)	Therapy
Cat/Dog Bites	*Pasturella multocida;* *Capnocytophaga*	Amox/clav (Doxy; FQ or SXT + Clinda)
Human bites	Mixed flora *Eikenella corrodens*	Hand Surgeon; ATB as above
Fresh water injury	*Aeromonas*	FQ; Broad Spectrum Beta-lactam
Salt water injury (warm)	*Vibrio vulnificus*	FQ; Ceftazidime
Thorn , Moss	*Sporothrix schenckii*	Potassium iodine
Meat-packing	*Erysipelothrix*	Penicillin
Cotton sorters	Anthrax	Penicillin
Cat scratch	*Bartonella*	Azithromycin

TAKE HOME POINTS

- Most commonly caused by *Staphylococcus aureus and Streptococcus pyogenes*
- Risk factors for developing SSTIs include breakdown of the epidermis, surgical procedures, crowding, comorbidities, venous stasis, lymphedema
- Most SSTIs can be managed on an outpatient basis, although patients with evidence of rapidly progressive infection, high fevers, or other signs of systemic inflammatory response should be monitored in the hospital setting

TAKE HOME POINTS

- Superficial SSTIs typically do not require systemic antibiotic treatment and can be managed with topical antibiotic agents, heat packs, or incision and drainage.

- Systemic antibiotic agents that provide coverage for both *Staphylococcus aureus and Streptococcus pyogenes* are most commonly used as empiric therapy for both uncomplicated and complicated deeper infections.

Reference:

- Ryan, Kenneth J.. Sherris Medical Microbiology, Seventh Edition. McGraw-Hill Education.
  - Skin and Wound Infections, part of the chapter on Infectious Diseases: Syndromes and Etiologies
  - *Staphylococci*, chapter 24
  - *Streptococci*, chapter 25