Revised by
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MEDICINE
KING SAUD UNIVERSITY

Microbiology
team 436

Lecture :
1-Skin and Soft-Tissue Infections

important
Extra notes
Doctors notes

وتقال هذه الجملة إذا دهم الإنسان أمر عظيم لا "لا حول ولا قوة إلا بالله العلي العظيم" يستطيعه ، أو يصعب عليه القيام به.

Objectives:

1. Describe the anatomical structure of skin and soft tissues.
2. Differentiate the various types of skin and soft tissue infections and there clinical presentation.
3. Name bacteria commonly involved in skin and soft tissue infections
4. Describe the pathogenesis of various types of skin and soft tissue infections 5. Recognize specimens that are acceptable and unacceptable for different types of skin and soft tissue infections
6. Describe the microscopic and colony morphology and the results of differentiating bacteria isolates in addition to other non-microbiological investigation
7. Discuss antimicrobial susceptibility testing of anaerobes including methods and antimicrobial agents to be tested.
8. Describe the major approaches to treat of skin and soft tissue infections ,either medical or surgical.

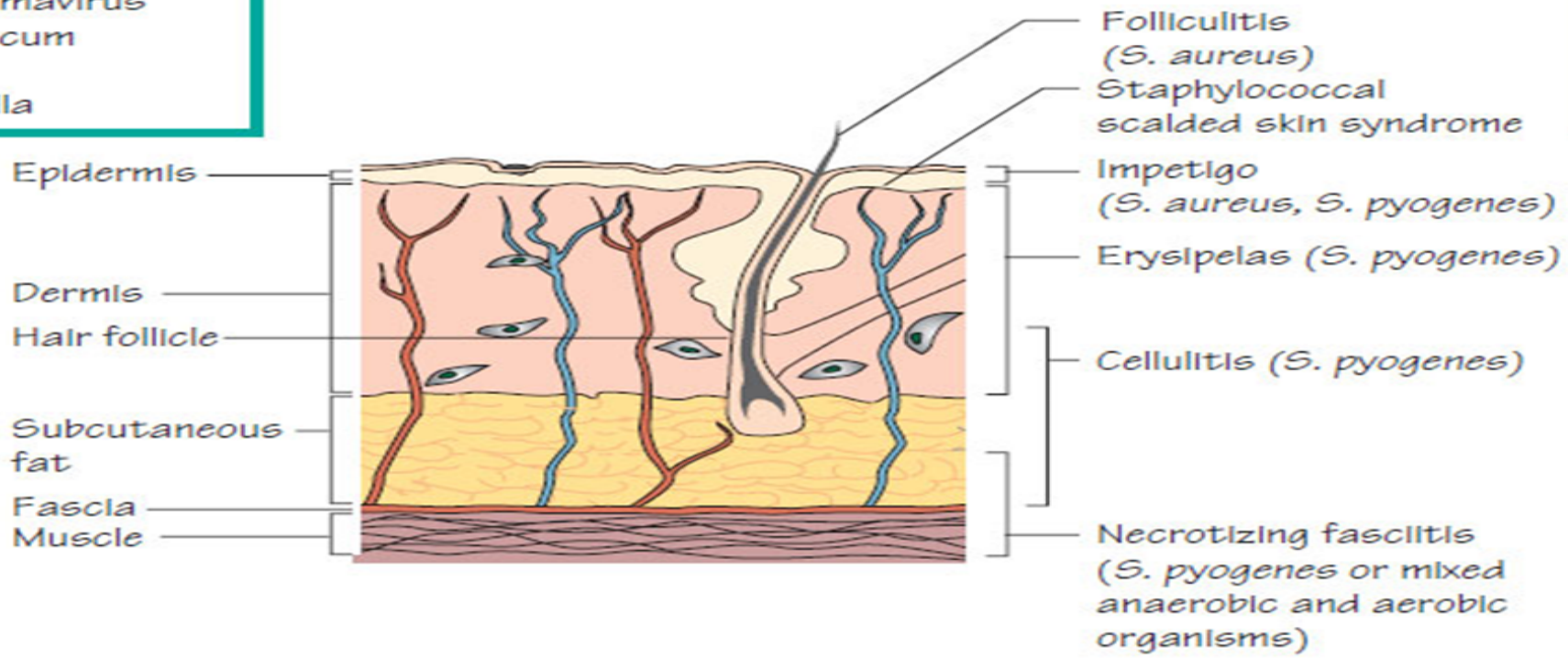
VIRAL PATHOGENS

- Herpes simplex
- Papillomavirus
- Molluscum
- Orf
- Varicella

*

FUNGAL PATHOGENS

- Epidermophyton
- Microsporum
- Trichophyton
- Candida
- Malassezia furfur



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

*This picture summarize the lecture return to it when you finish.

*Only in males slides

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:
  severity of infection
- Investigation:
  -CBCs, Chemistry
  -Swab, biopsy or aspiration*
  -Radiographic procedures*
  -Level of infection and the presence of gas or abscess.
- Diagnostic and therapeutic:
  - Surgical* exploration or debridement
  - Antibiotics treatment

*Surgical : diagnostic (very important to determine if the infection and whither it is deep or superficial) and therapeutic (if it's severe it might need amputating)

*Radiology (CT or X-Ray) : primary to determine if there is bone infection or if there is gas.

*Aspirate :For pus or exudate

Introduction:

-Soft tissue definition: anything other than bones.

- Soft tissue infections : It is a Common disease.
- Can be mild to moderate or sever muscle or bone and lungs or heart valves infection.
- Most **common Cause** are: **Staphylococcus aureus and streptococcus.**
- Emerging **antibiotic resistance** among:
  - -Staphylococcus aureus (**methicillin resistance**).
  - -Methicillin drug is the laboratory name for cloxicillin drug
  - -Streptococcus pyogenes (**erythromycin resistance**).

RAJAN

*Zoom in the image if not clear

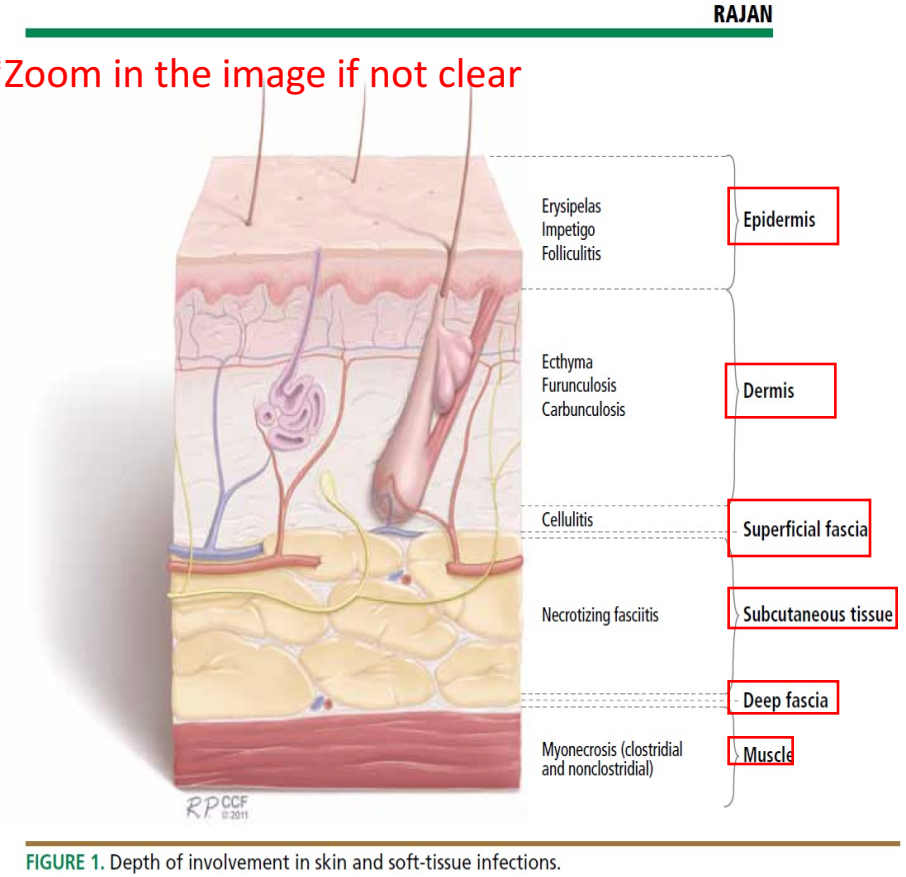


FIGURE 1. Depth of involvement in skin and soft-tissue infections.

Important to know the:
1- Name of the **syndrome**.
2- **Organisms** causing it.
3- Clinical **presentation**.
4- **Antibiotics**.

-You should differentiate between epidermis, dermis, subcutaneous infections and is it invading other tissues like muscles or bones to choose the right management.
-The more the organism has powerful toxins and enzyme the more it spread deeply, and he may devolve gas gangrene. For example : clostridium perfringase

Impetigo - (pyoderma*): Definition / causes / characteristics / treatment

Definition:

- It's a **common** skin infection, in **Children 2–5 years** in tropical or subtropical regions. **Very superficial in epidermis**

Causes:

- Always caused by β-hemolytic streptococci (Nonbullous) and/or S.aureus (Bullous*)

Characteristics:

- **Systemic symptoms** are usually absent.
- Consists of discrete purulent* lesions (**Blister* if it rupture, it's produce fluid (honey crust)**)
- Exposed areas of the body(**face and extremities**)
- Skin colonization- Inoculation by **abrasions, minor trauma, or insect bites**
- Poststreptococcal glomerulonephritis*.
- (anti–DNAse B) :(antideoxyribonuclease B) ; if there is a lot of AntiDNAse in the test then it means he have impetigo .

Treatment:

- **Cefazolin: covers Both Staphylococcus and streptococcus.**
- **Cloxacillin: covers Staphylococcus only**
- **Erythromycin: covers streptococcus only**
- **Mupirocin** It may lead to immune complication in some cases.

If patient has cellulitis, 1st drug you think of = Cefazolin

*After infection of impetigo by "group A"(beta hemolytic) Streptococcus , the patient might have post streptococcal glomerulonephritis. streptococcal glomerulonephritis: it is immunological response which affects kidney, it is primarily antigen-antibody complex reaction. This antibody is produced against cell wall of "A streptococcus "and accumulate in the glomerulus and cause acute glomerulonephritis and shows reversible renal failure

Pyoderma*:any skin disease that is pyogenic (has pus)) Purulent*: صديدي Blister*: الحبة أو البثرة Bulbous* =pus

Cutaneous abscesses: Definition / causes / characteristics / treatment

Definition:

- Collections of pus within the **dermis and deeper skin tissues**.

Causes :

- Typically **polymicrobial**, **S. aureus** alone in ~ 25 %
- Do Gram stain,culture, and **systemic antibiotics**

Characteristics:

- Painful, tender, and fluctuant
- **Multiple lesions**:
- cutaneous gangrene.
- severely impaired host defenses.
- extensive surrounding cellulitis.
- high fever.

Treatments:

- Incision and evacuation* of the pus.(فتح الخراج واستخراج الصديد منه)
- **Antibody: Cloxacillin (S.Aureus only)**

*Evacuation =drainage

Furuncles and carbuncles: Definition / causes / characteristics / treatment

Definition:

- **Furuncle or bolis**: infection of the hair follicle (folliculitis) ,**small** and affect **one** hair follicle
- **Carbuncle**: infection of **many** hair follicles, **big** and with coalescent inflammatory mass

Causes:

- usually caused by **S. aureus**

Characteristics

- extends through the dermis into the subcutaneous tissue (so it is Deeper than Cutaneous abscesses.)
- Carbuncle present in the **back of neck** especially diabetes patients

Treatment:

- 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 nares- 20-40%
- Mupirocin ointment(اسم مرهم)-to eradicate staphylococcal carriage nasal colonization

-*S. aureus* it is the normal flora in anterior nares

إذا فيه إصابة في العائلة راح تاخذهم كلهم وتاخذ منهم

Nose swap

وتشوف مين يحمل البكتيريا وتسوي له

Decolonization

وتعطيه معقمات ، للاستحمام مثلا

+ topical antibiotics

Outbreaks*: تفشي MSSA*=methicillin sensitive staph-aureus MRSA*= methicillin resistance staph-aureus

الكاربنكل عبارة عن أكثر من فرنكل

Erysipelas and Cellulitis:

ملخصها بشكل رائع ومختصر Team 435

*important

IMPORTANT QUESTIONS

Q1: Describe the lesion seen in the picture.
Redness/swelling (edema)/ the margin is well demarcated.
Q2: what is the most common organism?
Group A streptococci.
(If it was abscess.. then it is staph.)
Q3: What is the drug of choice?
Penicillin.

	Erysipelas	Cellulitis (Acute spreading)
Affects	The Upper Dermis (Epidermis) (Raised-clear Line Of Demarcation)	The Deeper Dermis And Subcutaneous Tissues
Caused by	- B-hemolytic Streptococci (Group A) - S. Pyogenes	- B-hemolytic Streptococci (A&b-diabetics) - S. Aureus : Commonly Causes Cellulitis - Haemophilus Influenzae in Children
	Well Demarcated, Edematous.	**Not** Demarcated
Affects	Infants, Young Children	All Ages
Clinical presentation	**VERY RED, Tender, Painful Plaque**	Tenderness And Redness That Spreads To Adjacent Sk
Treatment	Penicillin: IV Or Oral	Penicillin, Cloxacillin, **Cefazolin (cephalexin)** (Group A Strept) (S. Aureus Only) (Drug of Choice)

Basically, the most important things you must know so far is that:

1- **Impetigo and the rest of diseases** are caused by both staphylococcus aureus and streptococcus.
2- **Folliculitis** is caused by staphylococcus aureus.
3- **Erysipelas** is caused by Group A streptococci. (This group could cause sore throat and pharyngitis).

فيه تكملة للسيلولتس في السلايد الجاي

Cont-Cellulitis:

- **Risk factors**:
  - Obesity, venous insufficiency, lymphatic obstruction (operations), preexisting skin infections-ulceration, or eczema,
  - CA-MRSA (Community Association 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:**
  - ✓ **Vancomycin or linazolid** in case of MRSA
  - ✓ **Clindamycin, TMP-SMZ** for CaMRSA

Necrotizing Fasciitis:

- Also known as **flesh eating disease**.
- It is a **rare deep skin** and subcutaneous tissues infection.
- **The Most serious infection in Microbiology can kill patient.**
- Deep inflammation of fascia, **systemic**
- Usually present in **diabetic patient**
- Sometimes **present with as cellulitis**
- Most **common in arms, legs, and abdominal wall** and is **fatal** in 30%-40% of cases.

** **How can we differentiate between this infection and Cellulitis?**
In Necrotizing fasciitis, the patient has **severe pain**. The leg is the place where the redness, not overall the body, and the patient feels heaviness in the leg infected.

it's a must that there's **question in the exam** about fasciitis; why? Because it's a very serious infection.

Polymicrobial: Mixed organism.
Monomicrobial: One organism.

Streptococci group A:
Lead to necrotizing fasciitis.
Clostridium perfringens:
Lead to gas gangrene.

- **Two types:**
  - **Type 1:** is Polymicrobial
  - **Type 2** :which is Monomicrobial. (caused by one microorganism)
- **Caused by:**
  - ✓ Fournier's gangrene (testicular), (if localized in the testis or scrotum, or perineal region), Necrotizing cellulitis (another name for it).
  - ✓ Group A streptococcus (streptococcus pyogens)
  - ✓ Staphylococcus Aureus or CA-MRSA (community acquired – methicillin resistant staph aureus)
  - ✓ Clostridium Perfringens (gas in tissues)
  - ✓ Bacteroides Fragillis (other causative microorganism)
  - ✓ Vibrio Vulnificus (liver function)
  - ✓ Gram negative bacteria (synergy يعني متعاونة مع بكتيريا ثانية) : E.Coli , klebseilla, Pseudomonas.
  - ✓ -Fungi

** important (from 435 team)

Doctors Notes

- Most important sign is SEVERE PAIN.
- It is considered a clinical emergency.
- **Type 1** can be clostridium perfringens and group A streptococcus
- **Type 2** is group A alone
- It is confirmed by biopsy. Also, MRI is used before that.
- We do a Gram stain for it to determine the type (1or 2) and choose the correct antibiotic.
- We can give 2 antibiotics (Penicillin and Clindamycin) to treat it because it is an emergency, BUT surgery is always the best treatment.

- you don’t have to memorize the risk factors for Necrotizing Fasciitis , but read it

Necrotizing Fasciitis:

Risk factors:

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

Pathophysiology:

- Destruction of skin and muscles by releasing toxins due to:
  - 1- Streptococcal pyogenic exotoxins.
  - 2- Super-antigens in the cases of:
    - Non-specific activation of T-cells.
    - Overproduction of cytokines.
    - Severe systemic illness, e.g: toxic shock syndrome.

Super-antigens :are super inducer for immune system)

Necrotizing Fasciitis:

❖ 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)- to check for renal failure.

✓ **Surgery debridement :** amputation

✓ **Radiographic studies:**

- X-rays : subcutaneous gases
- Doppler CT or MRI - to evaluate the spread.

✓ **Microbiology:**

- Culture &Gram's stain
  (blood, tissue, pus aspirate)
- Susceptibility tests

Necrotizing Fasciitis:

Treatment:

- If clinically suspected **patient needs to be hospitalized** OR require admission to **ICU**(intensive care unite).
- Start **intravenous antibiotics immediately**.
- Antibiotic selection based on bacteria suspected.
- **broad spectrum antibiotic combinations against**:
  - **MRSA**: 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**

Antibiotics combinations :

- **Penicillin**/**clindamycin**/gentamicin.

(Given together, and they're the most important)

- Ampicillin/sulbactam
- Cefazolin plus metronidazol
- Piperacillin/tazobactam
- *Clostridium perfringens* - penicillin G

- **Hyperbaric oxygen therapy** (HBO) treatment

What is HBO treatment?

https://www.youtube.com/watch?v=tuRCq4nyn2Y

The role of surgery more important than antibiotics, why?

There's necrotic tissue with no blood supply, so if you give antibiotic, no matter how strong the antibiotic is, it'll not reach because there's no blood supply, also, the huge volume of bacteria makes the mission more difficult.

** **Why do we add clindamycin to Penicillin for treatment for fasciitis?**

1. Because it works on the ribosome > which lead to protein inhibit > which lead to stop proliferation of bacteria and inhibit the toxin.
2. Mood of action > when the bacteria growth fast and in huge number the penicillin works better (in the beginning hours), but when the bacteria slow in growth and the number is fixed the clindamycin work better (after a day or two).
3. Because the clindamycin won't stay half a minute in the blood it goes directly to the tissue.

** important (team435)

Pyomyositis:

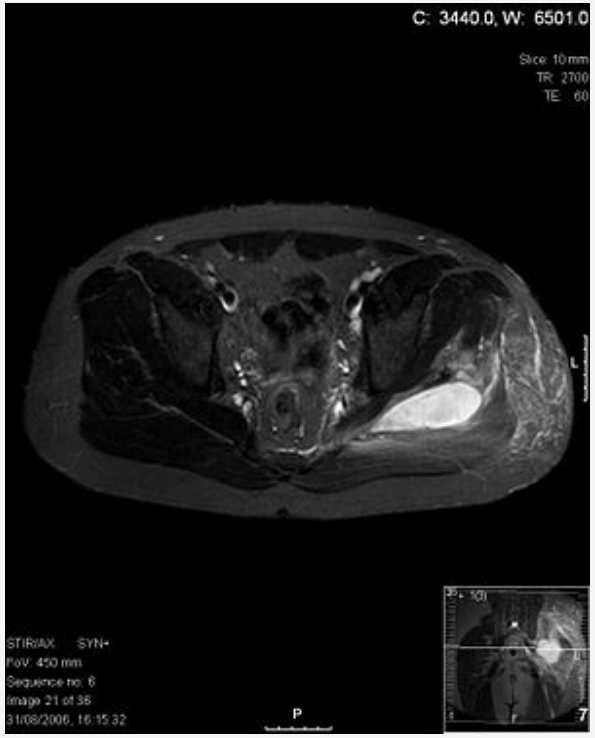
Definition: Acute bacterial infection of skeletal muscle, usually caused by Staph. Aureus.

- No predisposing penetrating wound, vascular insufficiency or contiguous infection.
- Most cases occur in the tropics (الدول الاستوائية).
- 60% of cases outside of tropics have predisposing risk factors (RF):

Diabetes mellitus, ethyl alcohol, liver disease, steroid prescriptions, HIV, hematologic malignancy.

History:

- 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.



Diagnosis:

X-ray, US, MRI or CT.

Treatment:

Surgical drainage and antibiotics.

You can read this slide

Doctors Notes

- - staph arues is resistant to penicillin
- -*S. aureus* it is the normal flora in anterior nares
- - cafazolin is the drug of choice in treatment of impetigo
- -we usually treat pus by draining it
- - erysipelas is well defined
- - erysipelas is most common in legs
- - cellulitis is poorly-defined
- - necrotizing fasciitis is treated with surgery and antibiotics
- If the abscess deep> anaerobic+ gram +ve
- If it superficial > staph

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 of the infection are mild and can be managed on an outpatient basis In case
- 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.
- 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.

Summary:

	Impetigo	Coetaneous abscesses	Furuncles /Carbuncles	Erysipelas	Cellulitis	Necrotizing fasciitis
Part affected	epidermis	Dermis and deeper skin tissue	dermis and subcutaneous tissue	Upper dermis	Deep dermis and subcutaneous tissue	Deep skin and subcutaneous tissue
Etiology	Caused by Beta Hemolytic streptococci / Staph. Aureus	Staph Aureus or polymicrobial	Staph Aureus	Beta hemolytic streptococci group A	Beta hemolytic streptococci (diabetics) Staph. Aureus (trauma) Homophiles influenza (children)	Streptococcus A and Clostridium perfrenges
Characteristics	Systemic symptom usually absent	Painful, tender and fluctuant	Hair follicle infection (folliculitis)	Red , tender , painful plaque	Risk factors : obesity , venous insufficiency , lymphatic obstruction, preexisting skin infection , ulceration , eczema	The most serious infection in Microbiology. Associated with gangrene and shock organ failure. Associated with gangrene and shock organ failure
Treatment	Cefazolen	Incision and evacuation of pus	Systemic antibiotics are usually unnecessary	Penicillin	Penicillin, cloxacillin Cefazolen	Penicillin , Clindamycin and Surgery

Did you study well ? https://www.onlineexambuilder.com/micro-1/exam-121025

SAQ: 42 year old male with Diabetes Mellitus came with sever pain, fever and his right leg was swelling, redness and blisters with subsequent necrosis.

Q1: What is the most likely Diagnose in this case ?

Necrotizing fasciitis

Q2: How can we differentiate between this infection in this case and cellulitis, Both of them, the patient come with pain and mild redness ?

In Necrotizing fasciitis, the patient has SEVER PAIN and feels heaviness in the leg infected.

Q3: Can radiologist confirm our diagnose ?

Yes , by X-rays to see if there is any subcutaneous gases or not.
by MRI & CT for soft tissue.

Q4: If we say that this case is Type(I) infection. What does it mean ?

This infection cause by polymicrobial agent (mixed organisms / more than one).

Q5: List some organism can cause this infection ?

Group A streptococcus / Clostridium perfringens / Bacteroides fragilis / Fungi.

Q6: The surgeon play an important role in this case by removing the necrotic tissue and sending a sample to Microbiology lab. What is the purpose of sending that sample after removing the necrotic tissue ?

To Know what are the causative organisms and therefore determine the suitable Antibiotics for treatment .

Q7: Why in this case we recommend to use combinations of Penicillin-clindamycin ?

The Clindamycin is more penetrate into soft tissue.
The Clindamycin works on the ribosome which lead to inhibit the synthesis of proteins which are in this case the toxins.

Q8: Streptococcus pyogenes are destroying the skin and muscle by releasing exotoxins which sometimes known as (Superantigen). What does it mean ?

They are a class of antigen that cause non-specific activation of T-cells, therefore overproduction of cytokines which may lead to Severe systemic illness such as Toxic shock syndrome.

The answers are below the questions , ZOOM to see it clear =)

GOOD LUCK!

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