

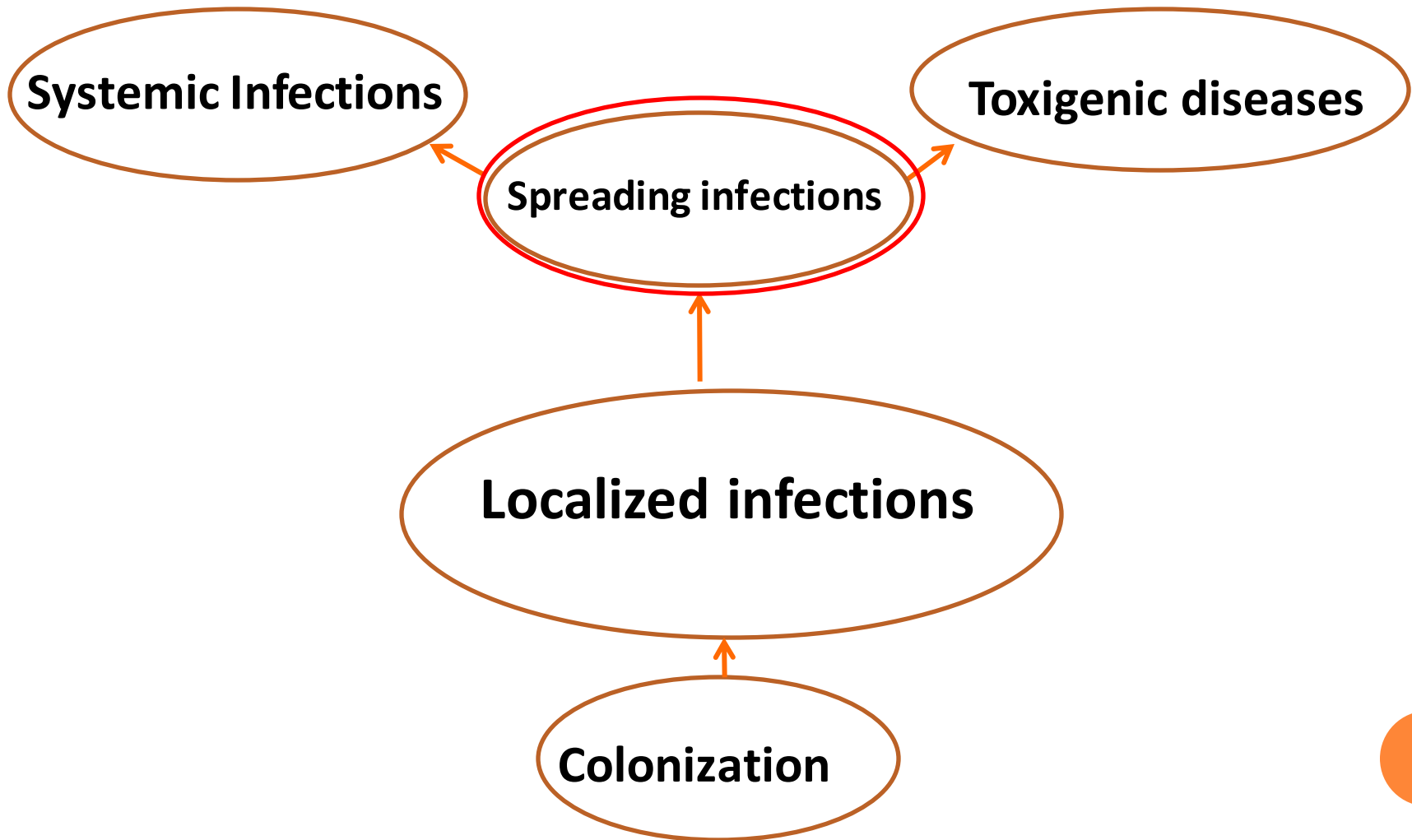
Bacterial Infections of the Skin

Lecture 2

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Levels of skin infections



Levels of skin infections

- **Spreading infections:**

- Impetigo
- Ecthyma
- Erysipelas
- Cellulitis

S. Pyogenes
(Some are caused by S. aureus)

- **Necrotizing fasciitis**



Streptococci

Pathogenic Streptococci

- *S. pyogenes* (group A)
- *S. agalactiae* (group B)
- Viridans streptococci
- *S. pneumoniae*
- *Enterococcus faecalis*

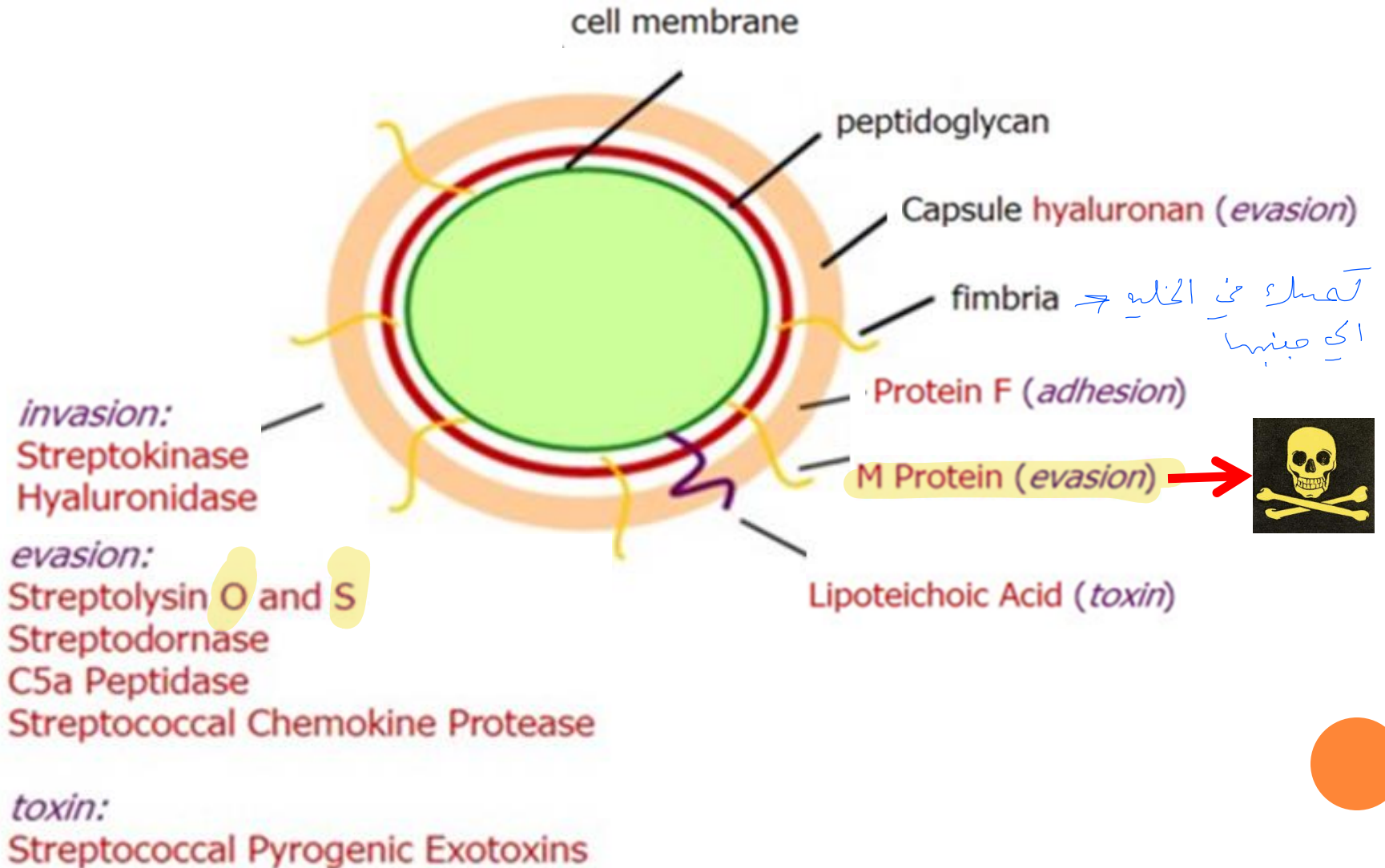
S. Pyogenes

- Group-A streptococci (GAS)
- β -hemolytic
- Most serious streptococcal pathogen
- Strict parasite
- Inhabits throat, nasopharynx, occasionally skin



S. pyogenes

Virulence factors



S. pyogenes

Streptococcus pyogenes Infections

Invasion via skin or mucosa



memory cell
Anti-M antibody (+)

Silent infection

Anti-M antibody (-)

Generalized invasive infection



Spreading skin infections

1- Impetigo

- Impetigo : eruption
- Called school sores
- Impetigo =Transient colonization + minor skin injury (ex. Insect bites)
- Most common in summer (increase insect numbers and the general hygiene is low)
- of red* ○ Contagious (if the fluid that oozes from the blisters touches an open area of the skin)



Spreading skin infections

1- Impetigo

Features

- One or many vesicles
- The blisters become oozing , break, expose moist and red skin
- Plasma dry after few days forming crusted area
- In sever cases the infection invades deeper layer forming ecthyma
- Three types:
 - Bullous
 - Non-bullous
 - Ecthyma

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Spreading skin infections

Bullous Impetigo (*S.aureus*)



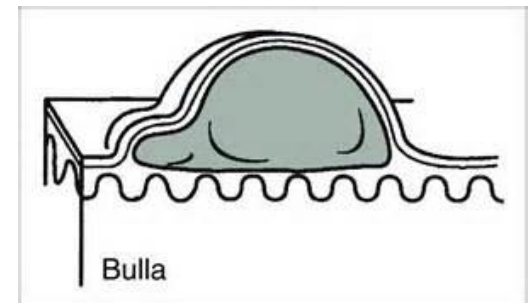
Bullous impetigo is a superficial skin infection that manifests as clusters of blisters that **enlarge rapidly to form bullae**. The bullae burst and expose larger bases, which become covered with **honey-colored crust**.

(Localized scalded skin syndrome)

Non-Bullous Impetigo (*S. pyogenes*)



Similar to bullous except that blisters are **slight and transient**



Spreading skin infections

Impetigo



Spreading skin infections

Impetigo

Diagnosis

Diagnosing impetigo is generally straightforward and based on the clinical appearance

Treatment

- Local antibiotics in mild and localized infection
- Removal of infected crusts and washing with soap and water help in treatment
- In widespread severe infection or when accompanied by lymphadenopathy an oral antibiotic is recommended

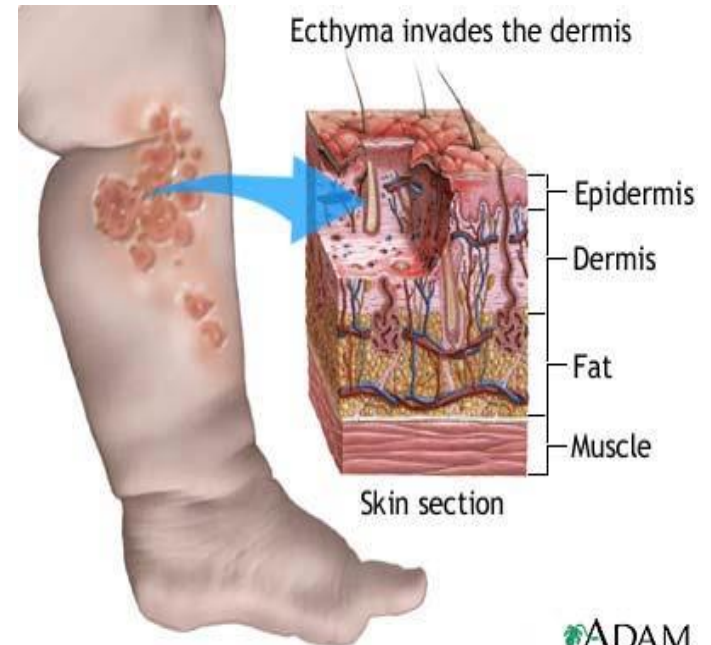


S. pyogenes

Spreading skin infections

Ecthyma

- Ecthyma is a skin infection similar to impetigo, but more deeply invasive to the deeper layer (dermis)
- The crust is much darker, thicker than of impetigo beneath which ulceration occurs
- Healing occurs after a few weeks with scars
- Treated by improved hygiene and antibiotics covering staphylococci and streptococci



Spreading skin infections

Ecthyma vs. Impetigo



Impetigo (staph.aureus and strep.pyogenes)	Ecthyma (strep.pyogenes)
superficial	deep
Honey or varnish color crusting	Chocolate color crusting
Crust is loosely adherent	Crust is tightly adherent
No ulcer on removal of crust	Ulcer on removal of crust
Common site: face	Common site: lower limbs
Heals without scarring	Heals with scarring



Spreading skin infections

Cellulitis and Erysipelas

Definition

Erysipelas (Red skin, Holy fire):

- Rapidly spreading painful bacterial infection of the dermis
- Blocking of dermal lymphatics and presents as well-defined spreading, edematous erythematous inflammation
تورم
- Erysipelas are caused by *S. pyogenes*.
- Symptoms including high fevers, shaking, chills, headaches, vomiting, and general illness within 48 h of the initial infection.
عرق

Cellulitis:

- Cellulitis and erysipelas are similar. The main difference is that cellulitis affects the dermis and the layer of fat just underneath it. Doctors can't always distinguish between them and they are both treated in the same way
- Cellulitis is caused by *S. pyogenes* and less commonly *S. aureus*

Spreading skin infections

Both Cellulitis and Erysipelas

- Infections can enter the skin through minor trauma, insect bites, dog bites, eczema, athlete's foot, surgical incisions and ulcer
- The leg is commonest site because it is exposed to skin injuries
- The face is the second most frequent site (butterfly distribution on the cheeks and bridge of the nose)



Spreading skin infections

Cellulitis and Erysipelas

Clinical features

Erysipelas



The main feature is a well defined raised edge (demarcated) reflecting the more superficial (dermal) involvement.

cellulitis



In cellulitis it is diffuse not demarcated edge.

Bacteria is carried away from the site of infection by the proteolytic enzymes as Pyrogenic exotoxin B produced By the bacteria itself in addition to the role of lymphatic vessels in the site of infection



Spreading skin infections

Cellulitis and Erysipelas

Clinical features



In erysipelas blistering is common associated with hemorrhage into the blister or in intact skin.



Sever cellulitis may show bullae and can progress to dermal necrosis. Frequent Lymphangitis and lymphadenopathy.



Spreading skin infections

Cellulitis and Erysipelas

Complications

Without treatment = fasciitis, myositis, subcutaneous abscesses, and septicemia.

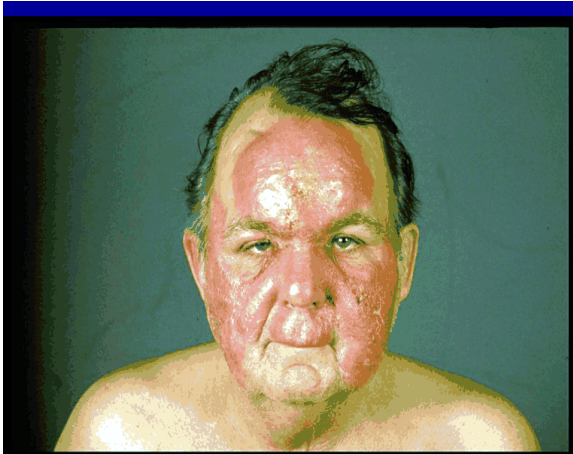
Treatment

- Should be treated with antibiotics that cover *S. pyogenes* and *S. aureus*.
- Oral or intravenous penicillin is the antibiotic of first choice.
- Vancomycin is used for facial erysipelas caused by MRSA.
- Treatment is usually for 10–14 days



Spreading skin infections

Erysipelas

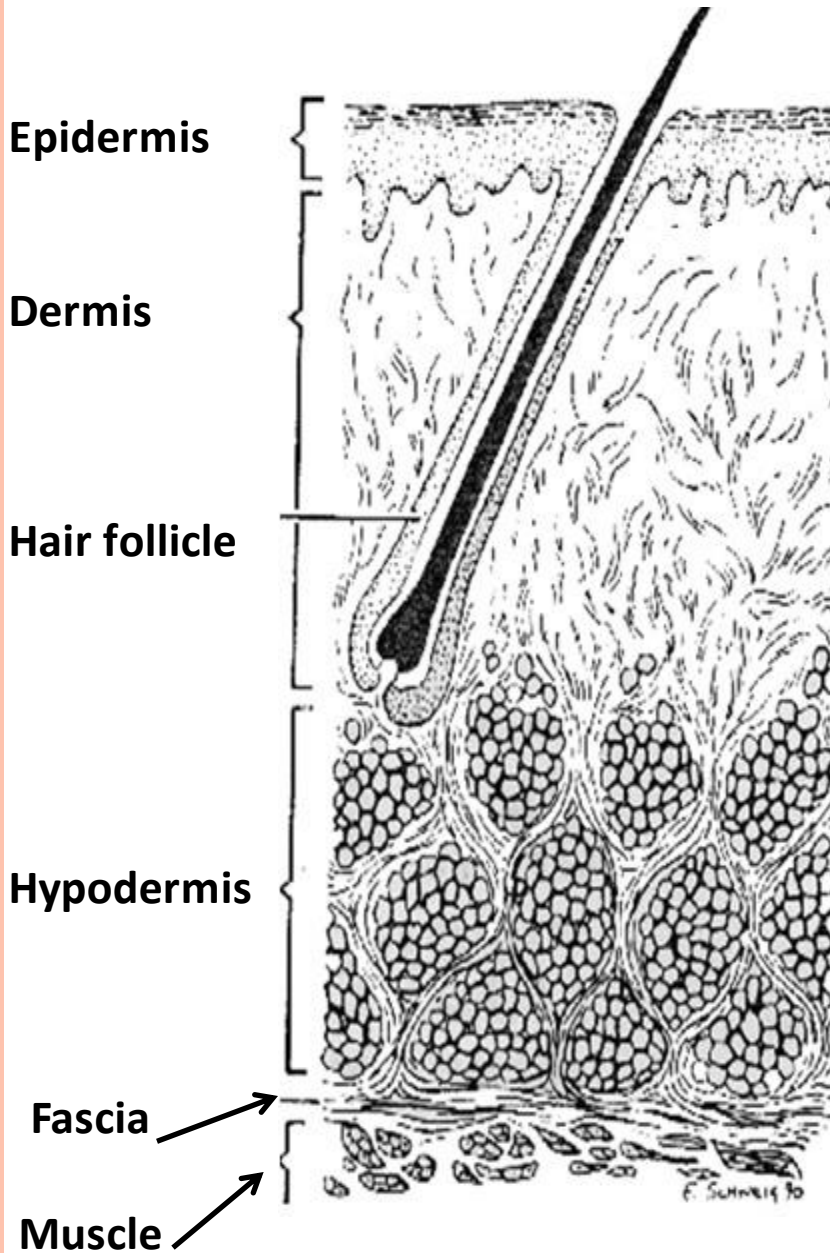


Erysipelas is characterized by shiny, raised, indurated, and tender plaque-like lesions with distinct margins.

Cellulitis



Spreading skin infections



Infection site	Etiologic agent
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Impetigo - - - - -> *S. aureus, S. pyogenes*

Ecthyma - - -> *S. pyogenes*

Erysipelas - - - - -> *S. pyogenes*

Cellulitis - - - - -> *S. Pyogenes (common)*
S. aureus (uncommon)





○ Case (cellulitis)

27 years old man was seen for an infection around his toe nail (paronychia). The lesion was drained and the pus cultured and gave beta-hemolytic *S. pyogenes*. The patient was not given antibiotic because the physician believed that the drainage was sufficient. Five days later the patient complained of fever and severe pain in his foot, which had become erythematous and swollen. His temperature was 40.2C, sweaty and hot.

- The patient then was admitted to hospital and diagnosed of Strptococcal cellulitis
- He was treated successfully with penicillin. Before starting therapy the blood culture also yielded *S. pyogenes*

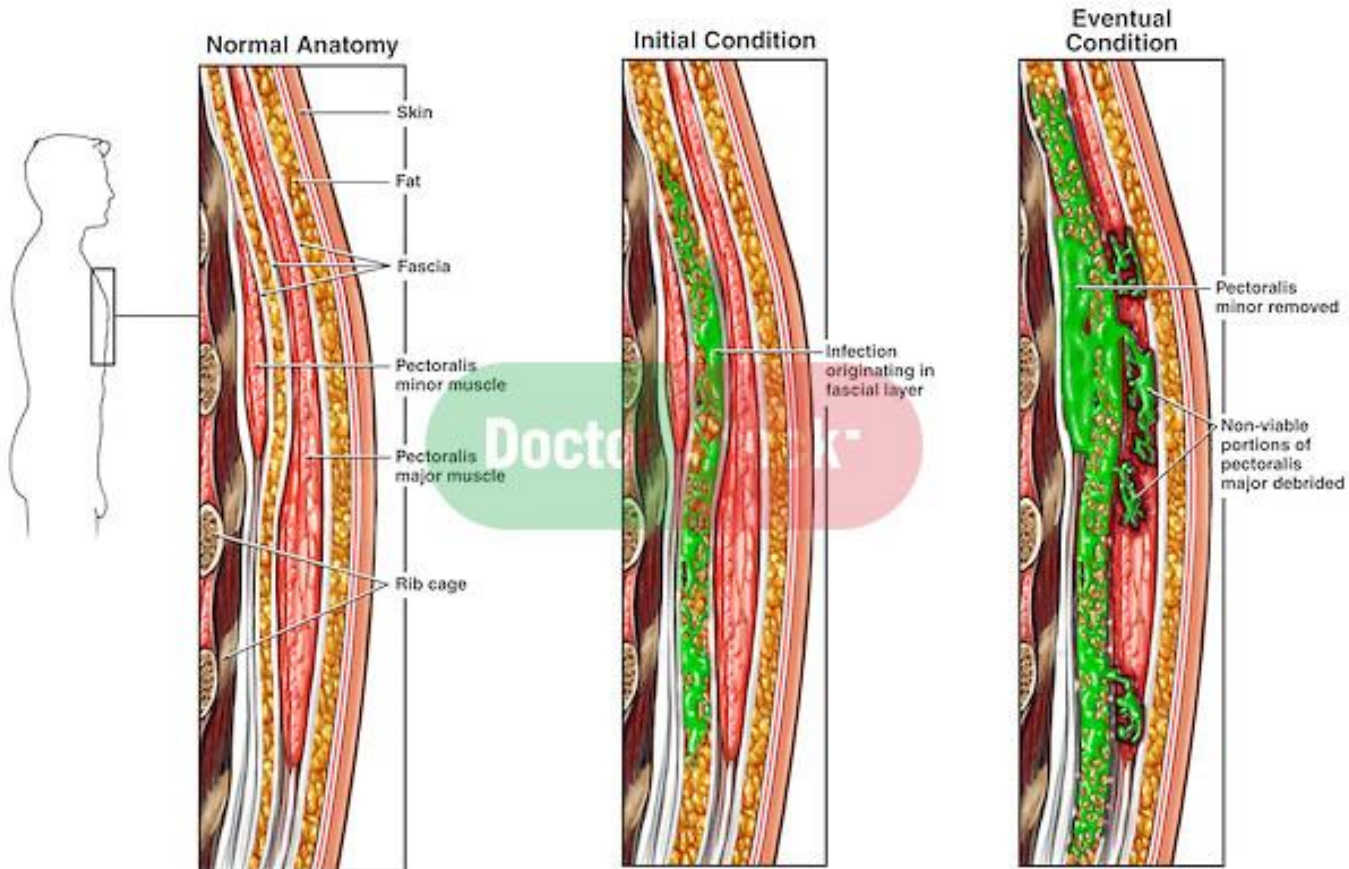


S. pyogenes

Spreading skin infections

Necrotizing fasciitis (NF) *انفصال بافتي نکروزان*

- Necrotizing = death of tissue
- Severe Bacterial infection that spreads rapidly through superficial and deep fascia



S. pyogenes

Spreading skin infections

Necrotizing fasciitis

- Incidence 1-20/100,000
- 30-70% mortality
- Causative agents:
 - monobacterial (*S. pyogenes*)
 - polymicrobial (candida, *E. coli*, *Klebsiella*, *vibrio vulnificus*,....)
 - gas gangrene (*Clostridium perfringens*)
- **Treatment:**
 - Prompt IV antibiotic treatment
 - Debridement or amputation is mandatory
- **Diagnosis:**
 - Gram stain from exudate
 - Biopsy
 - Culture and antibiotic sensitivity



S. pyogenes

Spreading skin infections

Necrotizing fasciitis

Indications of Necrotizing Fasciitis

- Rapid spreading of redness area ($\geq \frac{1}{2}$ inch per hour) this may be “Necrotizing Fasciitis”
- If the area is extremely painful
- If the person shows signs of bacteremia (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

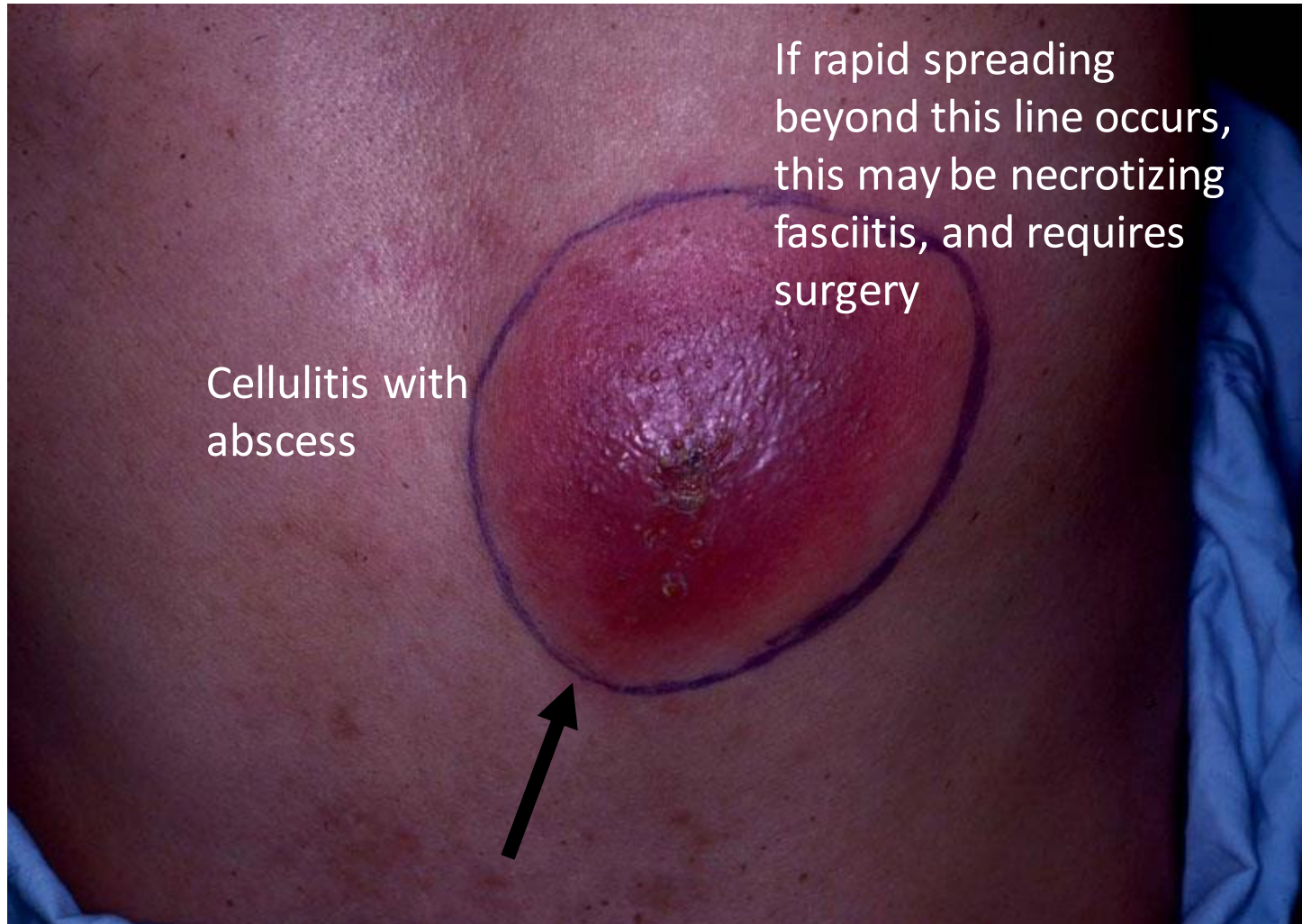


S. pyogenes

Spreading skin infections

Necrotizing fasciitis

Indications of Necrotizing Fasciitis



S. pyogenes

Spreading skin infections

Necrotizing fasciitis

Symptomes

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- The patient develops fever, malaise, and myalgias
- Extreme pain and tenderness over the involved skin and underlying muscle which is the **hallmark symptom**
- The intensity of the pain often causes suspicion of a torn or ruptured muscle
- Over the next several hours to days, the local pain progresses to anesthesia



S. pyogenes

Spreading skin infections

Necrotizing fasciitis



Acne



Propionibacterium

● Classification

- Two species *P. acnes* and *P. granulosum*.
- Are described as anaerobic diphtheroids, though some can grow in CO₂.
- Most clinical isolates are *P. acnes* which is part of the NF of skin.

● Morphology and cultural characteristics

- Pleomorphic, small G+B, may have Chinese letter configurations or may be branching.

normal flora

Propionibacterium

choclet Blood Agar

- Grow well on CBA, producing tiny translucent to opaque and white to gray colonies.
- Growth may be slow.
- Anaerobic, though occasional strains of *P. granulosum* grow in CO₂
- **Biochemistry**
 - Catalase +
 - Indole +/-
 - Ferment glucose
 - Produce caseinase

Propionibacterium

- Virulence factors

- Protease *پروٹین الیکٹرولائزنگ*

- Clinical significance –

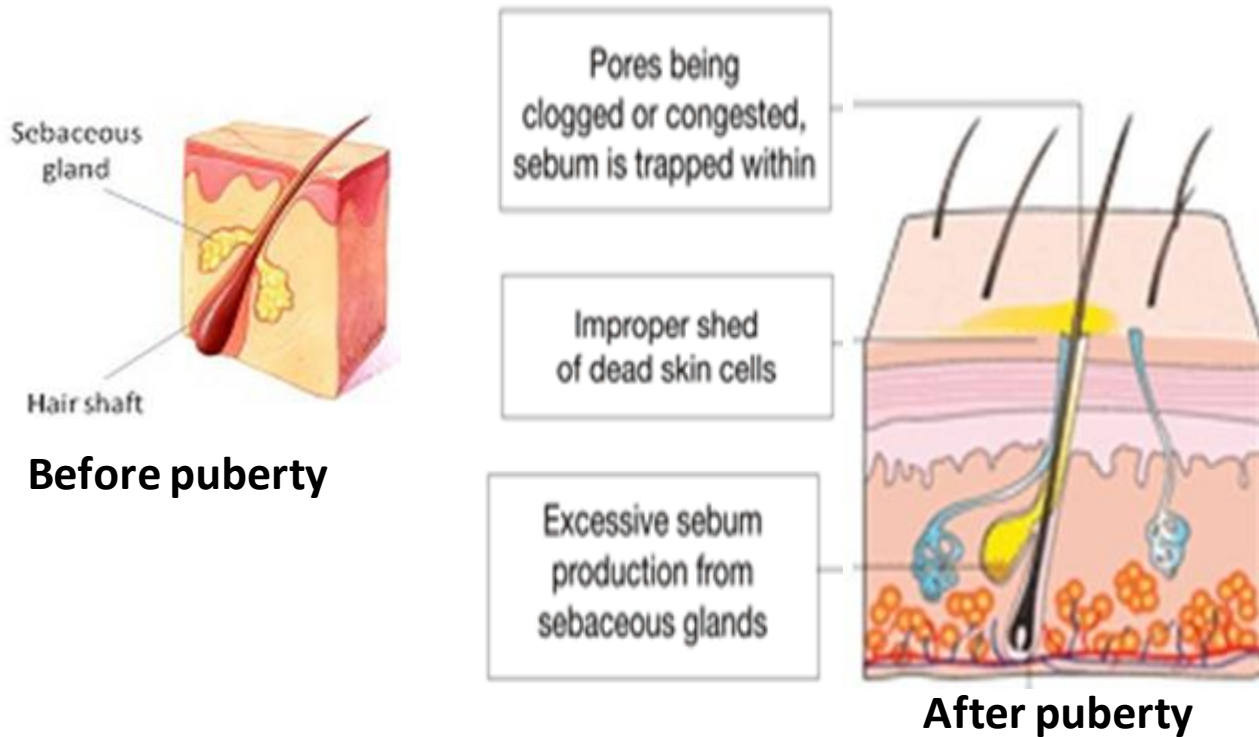
- Is part of skin NF
- Has been implicated in causing acne –
 - During adolescence more sebum is produced, and *P. acnes* metabolizes it to produce fatty acids.
 - These may contribute to the inflammatory response seen in acne.
- Has also been isolated from joint infections

Propionibacterium

- Antibiotic susceptibility/treatment
 - Tetracycline
 - Acutane – inhibits sebum formation and is only used in severe cases of acne because there are many side effects.

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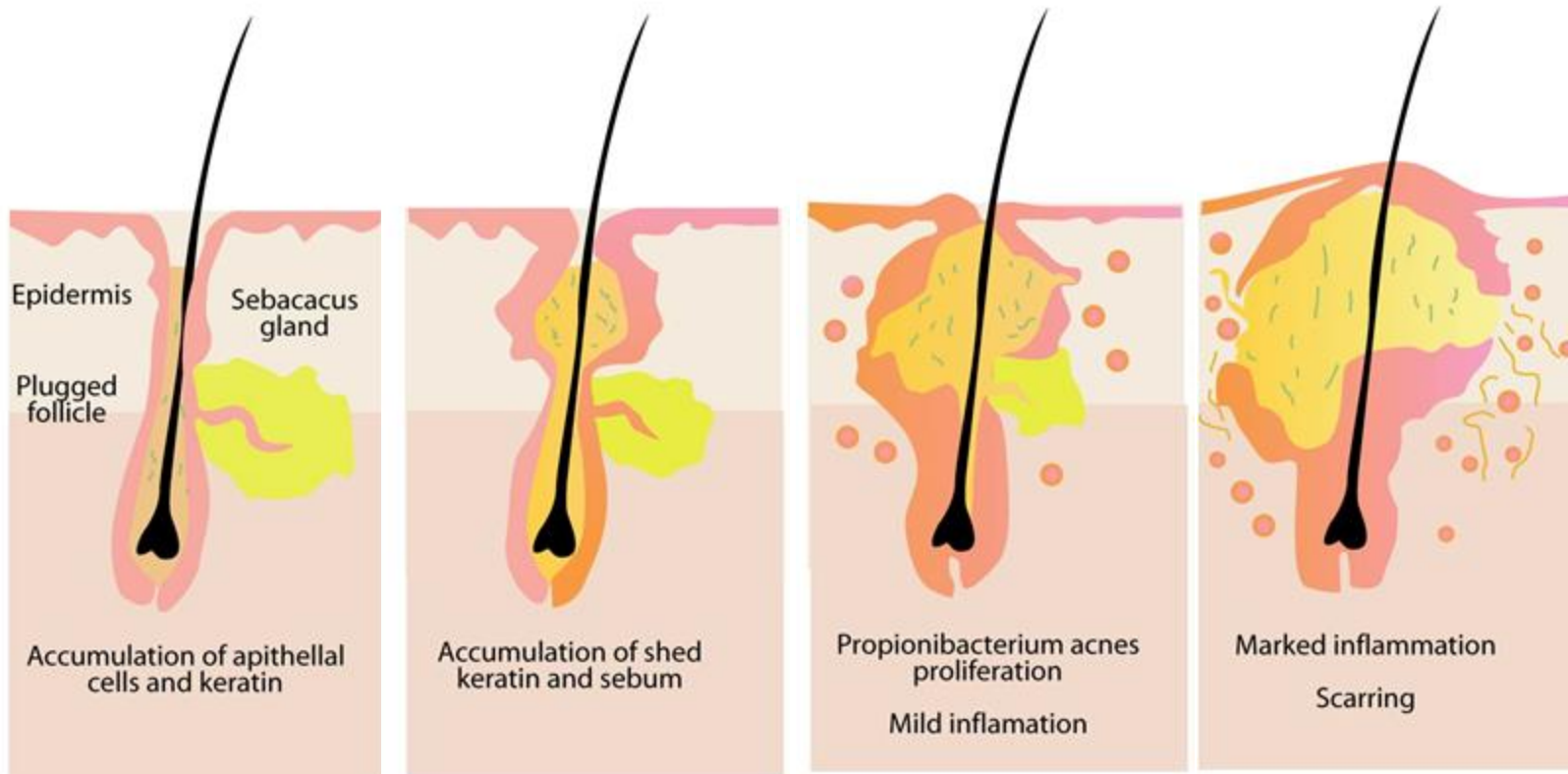
Pathophysiology of acne



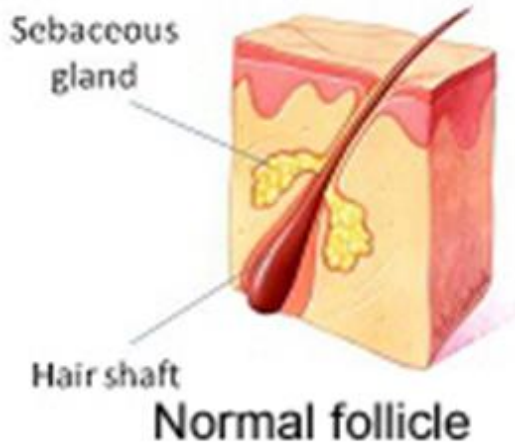
The production of sebum is under the control of **androgens**. During puberty the androgens stimulate the production of sebum plus increased keratinization and desquamation in sebaceous duct. This causing blockage of ducts and this turns the gland as a sac for the multiplication of *P. acnes* and other flora (yeast, staph, micrococcus).



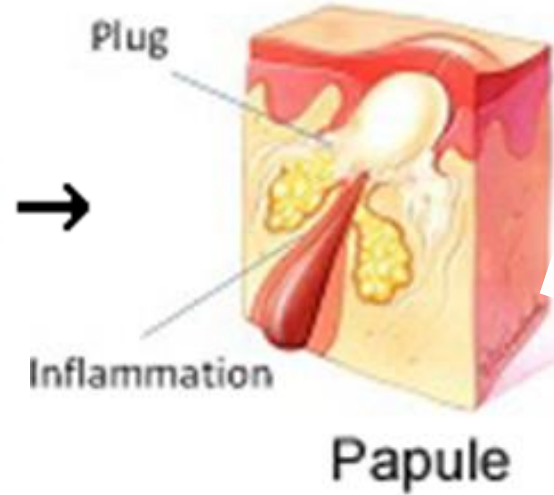
Acne



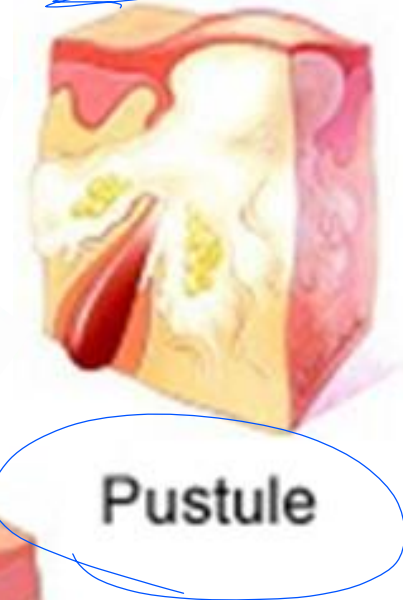
Stages of acne development



If the inflammation is deeper, a papule (pimple) is formed



If the inflammation is right near the surface, a pustule is formed



If the inflammation expands deeper it becomes a cyst or nodule.



STAPH. EPIDERMIDIS

Coagulase **positive** staphylococci

- *Staphylococcus aureus*

Coagulase **negative** staphylococci

- *Staphylococcus epidermidis*
- *Staphylococcus saprophyticus*



Staphylococcal diseases

TABLE 15-2 Important Features of Pathogenesis by Staphylococci

Organism	Type of Pathogenesis	Typical Disease	Predisposing Factor	Mode of Prevention	
<i>Sta. aureus</i>	1. Toxigenic (superantigen)	Toxic shock syndrome	Vaginal or nasal tampons	Reduce time of tampon use	
		Food poisoning	Improper food storage	Refrigerate food	
	2. Pyogenic (abscess)	a. Local	Skin infection (e.g., impetigo surgical-wound infections)	Poor skin hygiene; failure to follow aseptic procedures	Cleanliness; handwashing; reduce nasal carriage
<i>Sta. epidermidis</i>	Pyogenic	Infections of intravenous catheter sites and prosthetic devices	Failure to follow aseptic procedures or remove IV catheters promptly	Handwashing; remove IV catheters promptly	
<i>Sta. saprophyticus</i>	Pyogenic	Urinary tract infection	Sexual activity		

IV = intravenous.

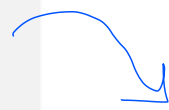
¹For simplicity, many forms of disseminated diseases caused by *Sta. aureus* (e.g., osteomyelitis, arthritis, were not included in the table).



Feature	Impetigo	Ecthyma	Cellulitis	Erysipelas	Necrotizing Fasciitis
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eruption
 ○ Called school sores

(Red skin, Holy fire):



Severity	Mild	Mild to moderate	Moderate to severe	Moderate to severe	Life-threatening
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Handwritten scribble
 painful

○ **Diagnosis:**
 > Gram stain from exudate
 > Biopsy
 > Culture and antibiotic sensitivity

Bacteria	S. aureus, S. pyogenes	<i>Handwritten scribble</i> S. pyogenes	S. pyogenes, S. aureus	S. pyogenes	S. pyogenes, S. aureus (and others)
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blisters that enlarge rapidly to form bullae.
 honey-colored crust.

Bullous

Non-Bullous blisters are slight and transient

> polymicrobial (candida, E. coli, Klebsiella, vibrio vulnificus,...)
 > gas gangrene (Clostridium perfringens)

Depth of Infection	Superficial (epidermis)	Deeper (dermis) ulceration occurs	Dermis and fat layer	Dermis	Dermis, fascia, muscle
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○ Blocking of dermal lymphatics

Features
 ○ One or many vesicles
 ○ The blisters become oozing, break, expose moist and red skin
 ○ Plasma dry after few days forming crusted area
 ○ In severe cases the infection invades deeper layer forming ecthyma
 Three types:
 - Bullous
 - Non-bullous
 - Ecthyma

Lesions	Blisters, crusts	Darker, thicker crusts	Diffuse redness, swelling	Well-defined, raised edge	Rapidly spreading redness
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edematous erythematous inflammation

blistering is common associated with hemorrhage into the blister or in intact skin.

(≥ ½ inch per hour)

Progression	May progress to	Heals with scars	May become necrotic	May become necrotic	Fasciitis, myositis, sepsis
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Frequent lymphangitis and lymphadenopathy

Feature	Impetigo	Ecthyma	Cellulitis	Erysipelas	Necrotizing Fasciitis
			<ul style="list-style-type: none"> The leg is commonest site because it is exposed to skin injuries The face is the second most frequent site (butterfly distribution on the cheeks and bridge of the nose) 		<ul style="list-style-type: none"> Extreme pain and tenderness over the involved skin and underlying muscle which is the hallmark symptom The intensity of the pain often causes suspicion of a torn or ruptured muscle Over the next several hours to days, the local pain progresses to anesthesia
	ecthyma		<p>Complications</p> <p>Without treatment = fasciitis, myositis, subcutaneous abscesses, and septicemia.</p>		
Pain	Mild	Mild to moderate	Moderate to severe	Moderate to severe	Extreme pain
Symptoms	None or mild	None or mild	Fever, chills, malaise	Fever, chills, malaise, shaking <i>general illness</i>	Fever, chills, malaise, weakness <i>myalgias</i>
Spread	Contagious	Less contagious	Can spread	Can spread	Rapidly spreading
Treatment	Topical antibiotics <p>Treatment</p> <ul style="list-style-type: none"> Local antibiotics in mild and localized infection Removal of infected crusts and washing with soap and water help in treatment In widespread severe infection or when accompanied by lymphadenopathy an oral antibiotic is recommended 	Antibiotics <p>Treated by improved hygiene and antibiotics covering staphylococci and streptococci</p>	Oral/IV antibiotic <p>Treatment</p> <ul style="list-style-type: none"> Should be treated with antibiotics that cover <i>S. pyogenes</i> and <i>S. aureus</i>. Oral or intravenous penicillin is the antibiotic of first choice. Vancomycin is used for facial erysipelas caused by MRSA. Treatment is usually for 10–14 days 	Oral/IV antibiotic <p>Treatment</p> <ul style="list-style-type: none"> Should be treated with antibiotics that cover <i>S. pyogenes</i> and <i>S. aureus</i>. Oral or intravenous penicillin is the antibiotic of first choice. Vancomycin is used for facial erysipelas caused by MRSA. Treatment is usually for 10–14 days 	Urgent surgery, antibiotic <p><i>تخفيف</i> <i>تبر</i></p> <p>Depidmmt or amputation is mandatory.</p>
Edge	Not well-defined	Not well-defined	Diffuse	Well-defined, raised	Not applicable
Blisters	Yes (especially bullous)	No	May occur	Common	Not applicable

Feature	Impetigo	Ecthyma	Cellulitis	Erysipelas	Necrotizing Fasciitis
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Cause	Skin trauma, hygiene	Progression from Impetigo	Skin trauma, bites, etc.	Skin trauma, bites, etc.	Skin trauma, bites, etc.
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Most common in summer (increase insect numbers and the general hygiene is low)

Doctors can't always distinguish between them and they are both treated in the same way

Infections can enter the skin through minor trauma, insect bites, dog bites, eczema, athlete's foot, surgical incisions and ulcer

Similarities:

- All are caused by bacterial infections, most commonly staphylococcus or streptococcus.
- All can start from minor skin trauma like insect bites or eczema.
- All can be treated with antibiotics (topical or oral/IV depending on severity).
- Left untreated, all can lead to more serious complications.

Differences:

- Impetigo is the most superficial infection and least severe.
- Ecthyma is a deeper version of Impetigo with darker crusts and scarring.
- Cellulitis and Erysipelas affect deeper layers and cause more swelling and pain. Erysipelas has a well-defined, raised edge.
- Necrotizing Fasciitis is the most severe and rapidly spreads, causing tissue death and requiring urgent surgery.

Key Points:

- Early diagnosis and treatment are crucial for all these infections.
- Necrotizing Fasciitis requires immediate medical attention due to its rapid progression and high mortality rate.
- If you experience rapidly spreading redness, extreme pain, or signs of systemic illness (fever, weakness), seek medical help immediately.



Impetigo (staph.aureus and strep.pyogenes)	Ecthyma (strep pyogenes)
superficial	deep
Honey or varnish color crusting	Chocolate color crusting
Crust is loosely adherent	Crust is tightly adherent
No ulcer on removal of crust	Ulcer on removal of crust
Common site: face	Common site: lower limbs
Heals without scarring	Heals with scarring