Skin and Soft Tissue Infection

Helen W. Boucher, MD, FACP, FIDSA, (Hon) FRCPI
Dean and Professor of Medicine
Tufts University School of Medicine
Chief Academic Officer, Tufts Medicine

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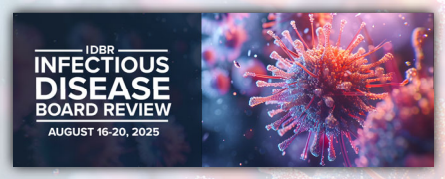

Disclosures of Financial Relationships with Relevant Commercial Interests

Editor
- ID Clinics of North America
- Antimicrobial Agents and Chemotherapy
- Sanford Guide

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Question #1

A 25-year-old female suffers a cat bite on the forearm. She presents one hour later for care.

If no antibacterial is administered, what is the percentage of such patients that get?

A. 0-10 %
B. 10-30 %
C. 30-70 %
D. 70-100 %

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Management of Animal Bites

- **Wound care: irrigation, debridement**
- **Image for fracture or as baseline for osteomyelitis or to detect foreign body ?**
- **Wound closure: NO**
- **Anticipatory (prophylactic) antibiotics**
- **Vaccines (tetanus and rabies)**

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Cat Bites

- 30-50% cat bites become infected with bacteria
- Wound types: puncture
- Microbiology: 63% polymicrobial
- Infection type:
  - Nonpurulent wound with cellulitis, lymphangitis, or both (42%)
  - Purulent wound without abscess (39%)
  - Abscesses (19%)

	Frequency (%)
Aerobic organisms	
Pasteurella	75
Streptococcus	46
Staphylococcus	35
Neisseria	35
Moraxella	35
Corynebacterium	28
Enterococcus	12
Bacillus	11
Anaerobic organisms	
Fusobacterium	33
Porphyromonas	30
Bacteroides	28

Abrahamian FM1, Goldstein EJ. Microbiology of animal bite wound infections. Clin Microbiol Rev. 2011 Apr;24(2):231-46. doi: 10.1128/CMR.00041-10; *NEJM 1999; 340: 85-92*

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Pasteurella multocida

- In saliva of > 90% of cats and over 50% of wounds get infected
- Different species, *Pasturella canis*, in saliva of 50% of dogs and only 2-10% get infected
- Small aerobic gram-negative bacillus
- Hard to remember antibiotic susceptibility profile, but amoxicillin sensitive; alternatives can be tricky

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Six Pathogens That Can Cause Infection After Cat Bites

1. *Pasteurella species*
2. Anaerobic bacteria: e.g., *Fusobacteria*
3. *Bartonella henselae (Cat Scratch disease)*
4. Rabies virus
5. *S. aureus*
6. *Streptococcal species*

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Question #2

PREVIEW QUESTION

A 50-year-old female with alcohol substance use disorder suffered a provoked dog bite

Bite was cleansed, tetanus toxoid given, and the dog placed under observation

Patient is post-elective splenectomy for ITP; she received pneumococcal vaccine one year ago

One day later, the patient is admitted to the ICU in septic shock with severe DIC and peripheral symmetric gangrene of the tips of her fingers/toes

Which one of the following is the most likely etiologic bacteria?

A. *Pasteurella canis*
B. *Capnocytophaga canimorsus*
C. *Fusobacterium spp.*
D. *Bartonella henselae*

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Dog Bites and Splenectomy

- Only 2-10 % of dog bites get infected
- Potential pathogens from
  - Dog's mouth:
    - *Pasteurella canis, Capnocytophaga canimorsus*
  - Human skin: *S. aureus, S. pyogenes*
- *Capnocytophaga is an important* cause of overwhelming sepsis in splenectomized patients
- *Capnocytophaga spp.*
  - *Susceptible to: amox/clav, pip/tazo, penicillin G, and clindamycin*
  - *Resistant to: TMP/SMX and maybe vancomycin*

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Question #3

A 45-year-old USA male experiencing homelessness presents with fever and severe polymyalgia. On physical exam, animal bite marks found around his left ankle. A faint rash is visible on his extremities. Within 24 hours, blood cultures are positive for pleomorphic gram-negative bacilli.

Which one of the following is the most likely diagnosis?

A. *Pasteurella multocida*
B. *Haemophilus parainfluenza*
C. *Spirillum minus*
D. *Streptobacillus moniliformis*

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Rat Bite Fever

- USA: *Streptobacillus moniliformis*
- Asia: *Spirillium minus*
- Bites or contaminated food/water
- *S. moniliformis*:
  - Fever, extremity rash
    - Macular/papular, pustular, petechial, purpuric
  - Symmetrical polyarthralgia
- Treatment: penicillin or doxycycline

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Question #4

PREVIEW QUESTION

A 35-year-old male suffers a clenched fist injury in a barroom brawl. He presents 18 hours later with fever and a tender, red, warm fist wound. Gram stain of bloody exudate shows a small gram-negative rod with some coccobacillary forms. The aerobic culture is positive for viridans streptococci

Which one of the following organisms is the likely etiologic agent?

A. *Viridans streptococci*
B. *Eikenella corrodens*
C. *Peptostreptococcus*
D. *Fusobacterium species*

Talan, D. CID 2003; 37: 1481

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Eikenella corrodens

- **Anaerobic small gram-negative bacillus**
- **Susceptible to:**
  - **Penicillins, fluoroquinolones, doxycycline, and extended spectrum cephalosporins (ceftriaxone, ceftazidime)**
- **Resistant to:**
  - **Cephalexin/cefazolin, clindamycin, erythromycin, diclox/oxacillin, metronidazole, and TMP/SMX**

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Question #5 (Extra Credit)

Medicinal leeches are applied to a non-healing leg ulcer.

Which one of the following pathogens is found in the "mouth" of the leech?

A. *Alcaligenes xylosoxidans*
B. *Aeromonas hydrophila*
C. *Acinetobacter baumannii*
D. *Arcanobacterium haemolyticum*

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Aeromonas spp.

- ***Aeromonas spp.*** **- aerobic gram-negative bacilli**
  - ***Aeromonas hydrophila*** **(most common)**
  - ***Aeromonas veronii***
  - ***Aeromonas shubertii***
- **Causes gastroenteritis (most common), wound infection (following trauma/exposure to leeches) or bacteremia after exposure to an Aeromonas species in fresh, brackish, or marine water**
- **Variable antimicrobial susceptibility; need culture and susceptibility testing of infected wound, stool, and blood**
  - **Resistance to beta-lactams and fluoroquinolones in selected areas of the world**
  - **Uniformly resistant to ampicillin, penicillin, and cefazolin**

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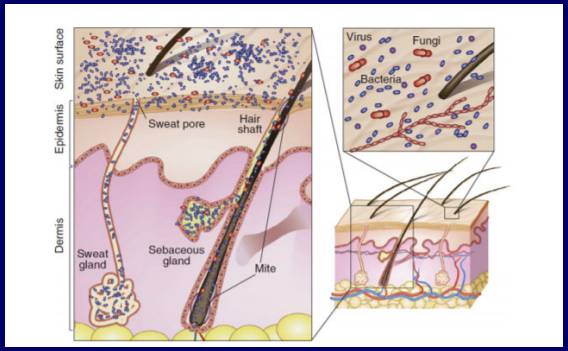
The Skin: Local Invasion by Structure



https://www.id.theclinics.com/article/S0891-5520(20)30090-8/pdf

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Skin Infections: Predisposing Factors

- Trauma to normal skin
- Immune deficiency
- Disrupted venous or lymphatic drainage
- Local inflammatory disorder
- Presence of foreign body
- Vascular insufficiency
- Obesity; poor hygiene

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S. aureus Skin Infection Predisposing Factors

Risk Factors Associated with MRSA SSTI

- Ethnicity (african american, hispanic compared with caucasian)
- Socioeconomic lower quintile
- Previous colonization or *S. aureus* infection
- Exposure: hospital, long-term care facility, household contacts
- Contact activities - daycare children, contact sports, military
- Comorbidities: diabetes, peripheral vascular disease, cardiovascular disease, chronic wounds
- Chronic kidney disease, dialysis dependence, intravenous drug use
- Pre-existing skin lesions (burns, eczematous dermatitis, etc.)
- Hereditary or iatrogenic neutrophil disorders

https://www.id.theclinics.com/article/S0891-5520(20)30090-8/pdf

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What is this?

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Superficial Folliculitis

- Purulence (sometimes mixed with blood) where hair follicles exit skin
- Etiology:
  1. *S. aureus*
  2. *P. aeruginosa* (hot tub)
  3. *C. albicans (esp. in obese patient)*
  4. *Malassezia furfur - lipophilic yeast (former Pityrosporum sp)*
  5. Idiopathic eosinophilic pustular folliculitis in AIDS patients

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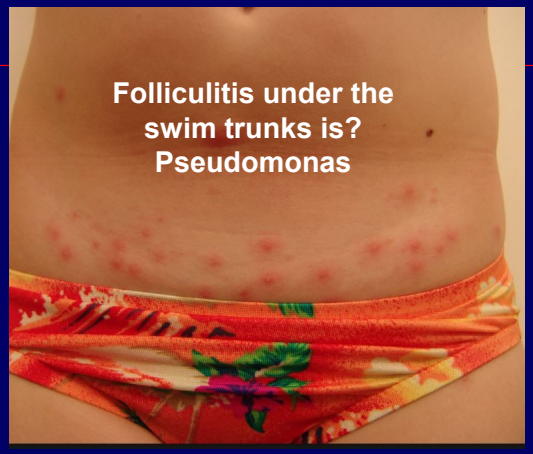

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Microbial Etiology?

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Streptococcal Infection of the Epidermis
Name of the Clinical Syndrome?

Infection of outer layers of epidermis with production of "honey-crust" scales

Prevalent in warm, humid environments – esp. in children.

Microbial etiology

- Streptococci: Groups A, B, C, G

Name?

- Streptococcal impetigo

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Fragile Bullae in Epidermis

Diagnosis?

- Bullous impetigo

Etiology?

- *S. aureus*

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Impetigo ("To Attack")

- Bullous impetigo: *S. aureus*
- Non-bullous impetigo: *S. pyogenes,* group A
- So, empiric therapy aimed at *S. aureus* as could be MRSA
- Topical: topical antibiotic ointment (TAO), mupirocin, retapamulin
- Oral rarely needed
  - e.g., clindamycin, doxycycline

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Complications of *S.pyogenes, S. dysgalactiae (Groups C&G)* impetigo

- Post-streptococcal glomerulonephritis due to nephritogenic strains
- Rheumatic fever has "never" occurred after streptococcal impetigo

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Acute onset of painful, rapidly spreading red plaque of inflammation involving epidermis, dermis, and subcutaneous fat.

NO PURULENCE

Diagnosis?

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Acute onset of painful, rapidly spreading red plaque of inflammation involving epidermis, dermis, and subcutaneous fat.

NO PURULENCE

Diagnosis:

Erysipelas: Non-purulent cellulitis

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Acute onset of painful, rapidly spreading red plaque of inflammation involving epidermis, dermis, and subcutaneous fat.

NO PURULENCE

Diagnosis:

- Erysipelas: Non-purulent cellulitis

Etiology?

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Acute onset of painful, rapidly spreading red plaque of inflammation involving epidermis, dermis, and subcutaneous fat. NO PURULENCE

Diagnosis?

- Erysipelas: Non-purulent cellulitis

Etiology?

- Hemolytic Streptococci: Group A
  - Now less common than groups C and G
- If on the face, could be *S. aureus*

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Erysipelas ("Red Skin")

- Acute onset of painful skin, rapid progression +/- lymphangitis
- Inflamed skin elevated, red, and demarcated
- Etiology: Streptococci--Groups A,B,C, & G (*S. pyogenes, S. agalactiae, S. dysgalactiae subsp. equisimilis)*
- Predisposition:
  - Lymphatic disruption, venous stasis

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Erysipelas and Cultures

- Most often, no culture necessary
- Can isolate *S. pyogenes* from fungal-infected skin between toes
- Low density of organisms
  - Punch biopsy positive in only 20-30%
- Blood cultures positive in </= 5%
- Confused with stasis dermatitis

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Stasis Dermatitis

- Looks like erysipelas; more frequent in obese individuals
- No fever
- Chronic, often bilateral, dependent edema
- Goes away with elevation
- Does not respond to antimicrobials
- Cadexomer iodine (IODOSORB) response rate 21% vs 5% for usual care

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Treatment of Erysipelas (Non-purulent "cellulitis")

- Elevation
- Topical antifungals between toes if tinea pedis present
- Penicillin, cephalosporins, clindamycin
- Avoid macrolides and TMP/SMX due to frequency of resistance

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Cellulitis

- Without localization or preceding macro or micro trauma: usually, Beta Strep. (usually GAS), extremities > face, elsewhere
- With localization (cut, pustule, etc.) or preceding trauma: *S. aureus*

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Severe Cellulitis

Microbiology: Streptococci (group A>B,C,G); less often *S. aureus*; rarely GNR

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Recurrent Cellulitis

- Frequently non-group A streptococci (esp. B, G)
- Relapse > recurrence
- Prophylaxis:
  - Benzathine penicillin IM
  - Oral penicillin; other systemic antibiotics
  - Decolonization (nasal, elsewhere)

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Helen W. Boucher, MD, FACP, FIDSA, (Hon) FRCPI

Risk Factors for Recurrent Erysipelas

- Lower Extremity
  - Post-bypass venectomy
  - Chronic lymphedema
  - Pelvic surgery
  - Lymphadenectomy
  - Pelvic irradiation
  - Chronic dermatophytosis
- Upper Extremity
  - Post-mastectomy/node dissection
- Breast
  - Post-breast conservation surgery, biopsy

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Erysipelothrix (Gram + Rod)

- On finger after cut/abrasion exposure to infected animal (swine) or fish
- Subacute erysipelas (erysipeloid)
- Severe throbbing pain
- Diagnosis: Culture of deep dermis (aspirate or biopsy)
- Treatment: Penicillin, cephalosporins, clindamycin, fluoroquinolone

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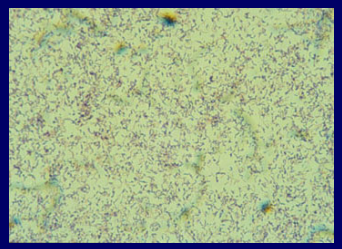
Erysipelothrix rhusiopathiae Infection



Gram stain of the organism (G+ rod) identified on culture

Resolving cellulitis caused by *Erysipelothrix rhusiopathiae*

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Question #6

A 53-year-old male construction worker has sudden onset of pain in his left calf. Within hours the skin and subcutaneous tissue of the calf are red, edematous and tender. Red “streaks” are seen spreading proximally

A short time later, patient is brought to the ER confused, vomiting, and hypotensive

- Temp 40C, diffuse erythema of the skin. Oxygen sat. 88% RA
- WBC 3000 with 25% polys and 50% band forms; platelet count is 60,000; creatinine 3.2mg/dl

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Question #6

Which one of the following is the most likely complication of the erysipelas?

A. Bacteremic shock due *to S. pyogenes*
B. Toxic shock due to *S. pyogenes*
C. Bacteremic shock due to *S. aureus*
D. Toxic shock due to *S. aureus*

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Toxic Shock Syn. (TSS): Staph vs Strep

Feature	Staphylococcal	Streptococcal
Predisposition	Tampon, surgery; colonization	Cuts, Burns, Varicella, erysipelas
Focal Pain	No	Yes
Tissue necrosis/inflammation	Rare	Common
N/V, renal failure/DIC	Yes	Yes
Erythroderma	Very common	Less Common
Bacteremia	Very rare (5%)	60%
Mortality	<6%	30-70%

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Sore Throat and Skin Rash

- **20-year-old male with 3 days of sore throat, fever, chills, and skin rash**
- **Rash is nonpruritic and involves abdomen, chest, back, arms, and legs**
- **Exam: exudative tonsillitis, strawberry tongue, rash, and tender cervical lymph nodes**

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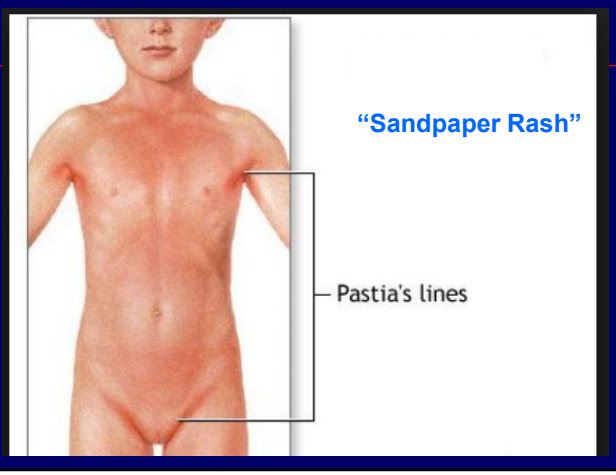

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The Most Likely Diagnosis?

- Infectious mononucleosis
- Coxsackie hand, foot and mouth disease
- Scarlet fever
- *Arcanobacterium hemolyticum*

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The Most Likely Diagnosis?

- Infectious mononucleosis
- Coxsackie hand, foot and mouth disease
- Scarlet fever
- *Arcanobacterium hemolyticum*

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Question #7

- 18-year-old male taking anti-seizure meds for idiopathic epilepsy develops fluctuant tender furuncle on right arm
- He develops fever and generalized erythroderma; wherever he is touched, a bullous lesion develops
- Skin biopsy shows intra-epidermal split in the skin

Which one of the following is the likely etiology of the skin bullae?

A. *S. aureus* scalded skin syndrome
B. Bullous pemphigus
C. Drug-induced Toxic epidermal necrolysis (TEN)
D. *S. pyogenes* necrotizing fasciitis

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Nikolsky sign

Exfoliative Toxins cause Epidermal split
- Stratum granulosum

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The Skin and Toxins of *S. aureus* and *S. pyogenes*

Organism	Toxin	Clinical Diagnosis
S. aureus colonization	TSST	TSS & Erythroderma
S. aureus colonization	Exfoliative toxin	Impetigo; scalded skin syndrome
Strep. pyogenes invasion	TSST	TSS; Erythroderma (not always)
Strep. pyogenes	Pyrogenic exotoxin	Pharyngitis; Scarlet Fever (sandpaper rash)

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Question #8

Erysipelas with loss of pain, hemorrhagic bullae, rapid progression..

What is the cause of the necrotizing fasciitis?

A. Streptococcal fasciitis
B. Staphylococcal fasciitis
C. Clostridial infection
D. Synergy between aerobe (*S. aureus, E. coli*) plus anaerobe (anaerobic strep, *Bacteroides sp*) equals Meleney's, Fournier's

Lancet ID 2015;15:109

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Necrotizing Fasciitis: At the Bedside

Sudden onset excruciating pain & systemic toxicity
Note swelling of leg & 2 small purple bullae on anterior shin
Pressures in the anterior/lateral compartments (blood at needle entry) elevated; surgical exploration performed

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Treatment of Necrotizing Fasciitis

- Think of it
  - Pain out of proportion to exam
  - Abnormal vital signs
  - Rapid spread
  - Tense edema
  - Ecchymoses
  - Crepitus
  - Loss of sensation
- Therapy = Surgical debridement: sometimes several times needed to achieve source control
- Watch out: imaging can be negative/misleading, patient may appear nontoxic at presentation (esp. if young, otherwise healthy)
- Appropriate antimicrobial therapy – *B*-lactam + clindamycin or linezolid (IDSA Guideline Update pending)

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Anatomy	Syndrome
Epidermis Skin Dermis	Erysipelas Impetigo Folliculitis Ecthyma Furunculosis Carbunculosis
Superficial fascia Subcutaneous tissue Subcutaneous fat, Nerves, arteries, veins Deep fascia	All of this is Cellulitis Necrotizing fasciitis
Muscle	Myonecrosis (clostridial and non-clostridial)

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Question #9

A 50-year-old male fisherman with known cirrhosis suffers an abrasion of his leg while harvesting oysters.
Within hours, the skin is red, painful, and hemorrhagic bullae appear.

Which one of the following conditions predisposes to this infection?

A. G6PD Deficiency
B. Hemochromatosis
C. Sickle cell disease
D. Achlorhydria

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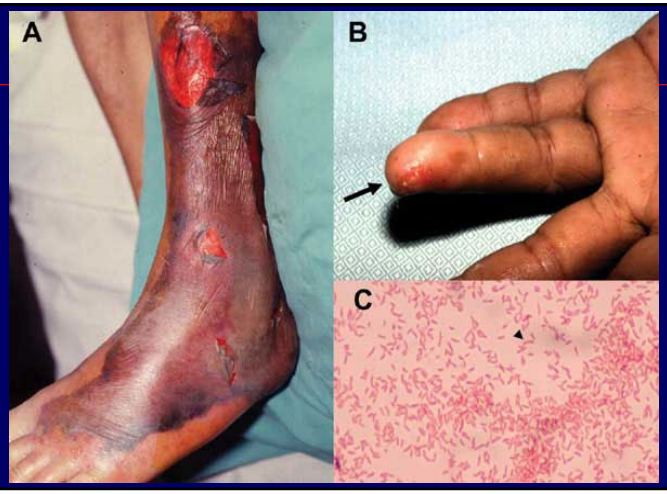

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Vibrio vulnificus

- Leading cause of shellfish (e.g., oysters)-associated deaths in USA
- Portal of entry: skin abrasions or GI tract
- Liver disease, hemochromatosis, and exposure to estuaries are major risk factors
- Infected wounds manifest as bullae in 75%; primary bacteremia also occurs
- Treatment (look up): doxycycline plus ceftriaxone (alternative is a fluoroquinolone)

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Organisms Whose Growth is Stimulated by Excess Iron

- *Vibrio vulnificus* ***V***
- *Escherichia coli* ***E***
- *Listeria monocytogenes* ***L***
- *Aeromonas hydrophilia* ***A***
- *Rhizopus species (Mucor)* ***R***
- *Yersinia enterocolitica* ***Y***

Definition: "The sails of a ship"

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Thank You!

- David Gilbert
- Paul Auwaerter
- Our patients and their families

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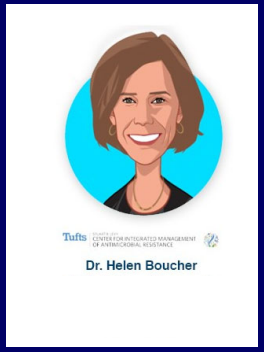
Questions, Comments?

- @hboucher3
- Helen.boucher@tufts.edu
- Helen.boucher@tuftsmedicine.org



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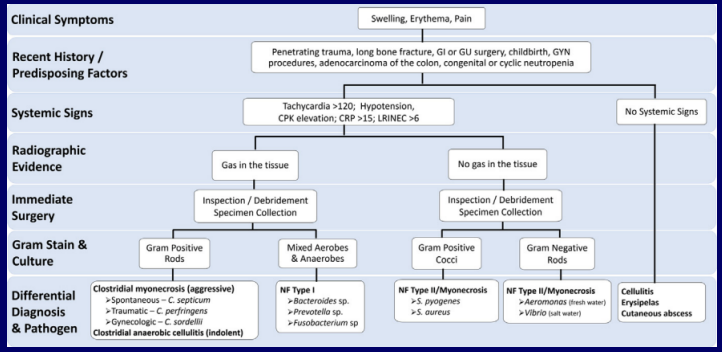
Algorithm for Diagnosis of Necrotizing Infections



Stevens, et al., Infect Dis Clin N Am 35 (2021) 135–155

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