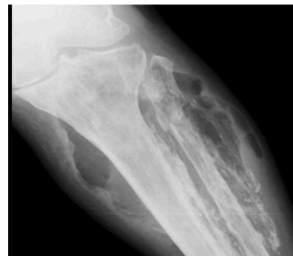


Podcast (Video Recorded Lecture Series):  
Soft Tissue Infections for the USMLE Step One Exam



My baby's got gas!



The Flesh Eaters:  
Necrotizing Fasciitis

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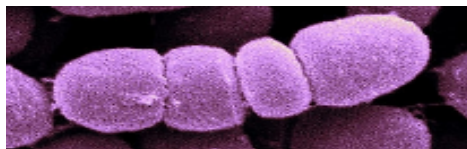
# MSK Infections

- Bone and Joint Infections
  - Septic Arthritis
  - Osteomyelitis
  - (Reactive Arthritis)
- Tick Borne (and related) Infections
  - Lyme Disease/Anaplasma (Ixodes)
    - Ehrlichiosis (Amblyomma; Lone Star)
  - Babesiosis (Ixodes)
  - RMSF (Dermacentor)
- Soft Tissue Infections
  - Clostridium perfringens → Myonecrosis
  - Necrotizing fasciitis → GAS
- ~~Viral~~
  - ~~Parvovirus (RA like presentation)~~

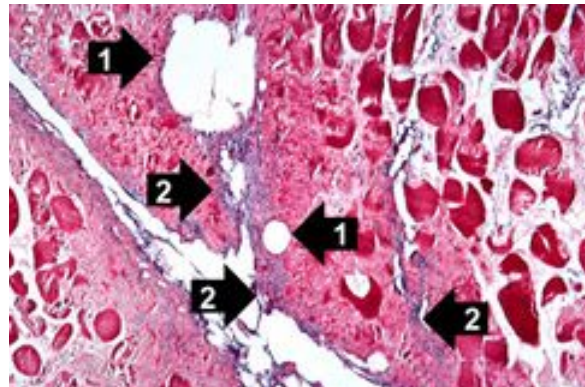
# Clostridium perfringens (Traumatic **Gas** Myonecrosis)

- Background

- Spectrum of illness includes: wound contamination, anaerobic cellulitis and **myonecrosis (gas gangrene)**.
- Perfect storm (myonecrosis): traumatic injury (introduces bug), presence of devitalized tissue (loss of blood supply) and delay in rx.
- Characterized by: **tissue necrosis** and **absence of inflammatory response** (**toxin-mediated**)

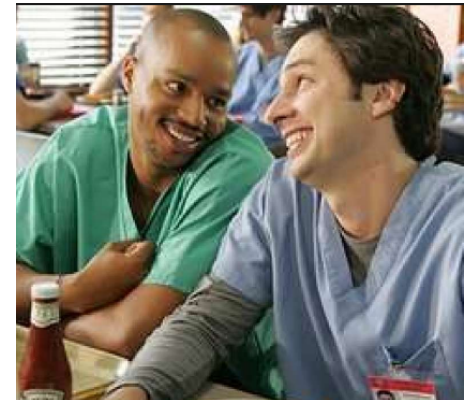


Gram +, spore-forming rod



Devitalized tissue

$\alpha$ -toxin (PPLase)



Surgical delay


# Clostridium perfringens

## (Traumatic **Gas** Myonecrosis)

- Background

- Spectrum of illness includes: wound contamination, **anaerobic cellulitis** and myonecrosis (gas gangrene).
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- Microbiology

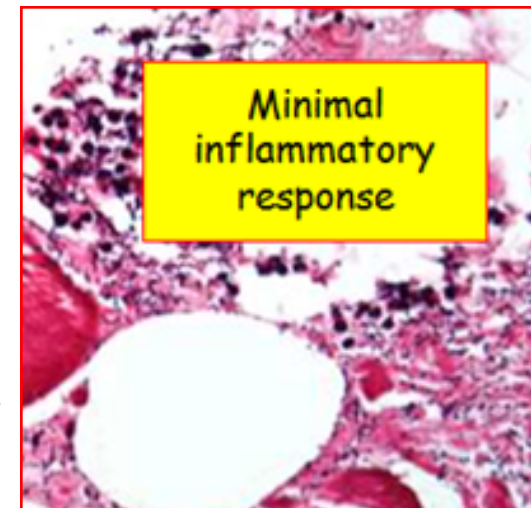
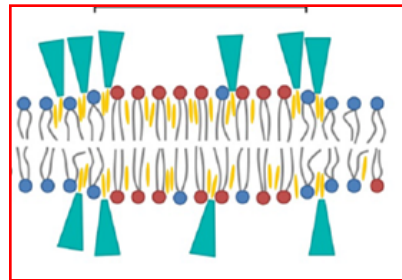
- 
- Gram (+) anaerobic, spore forming **rods** that produce **exotoxins**
  - Does not grow in presence of oxygen (**anaerobic**); **tissue death required**.

- Pathology (cellulitis v myonecrosis)

- Devitalized tissue (**anaerobic cellulitis**) **supports the growth** of organism with local growth and gas extending along fascial planes. No bacteremia or myonecrosis (during this phase).
- **Myonecrosis** is characterized by the invasion and destruction of healthy muscle tissue. Required: traumatic injury and **vascular compromise**.

# $\alpha$ -Toxin(s): Phospholipase C

- Alpha (essential) aka **Lecithinase** (degrades lecithin)
  - **Hemolytic** toxin with **Phospholipase C** (PLC) activity
    1. Catalyzes splitting of PPL molecules → cell membrane damage and cellular death
    2. Creates **occlusive vascular aggregates** that expand the anaerobic environment.
      - Upregulates adherence molecules on **PMN**/endothelial cells (they arrive but don't penetrate)
      - Stimulates **platelet** aggregation via IIb/IIIa activation



- Theta (perfringolysin O; nonessential)
  - Cytolysin (similar to streptolysin) - pore forming.

Devitalized, noninflammatory environment

Vascular Occlusion

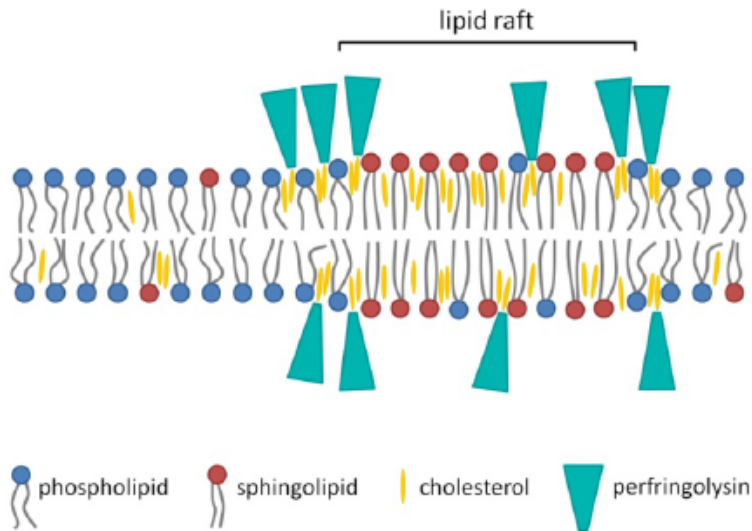
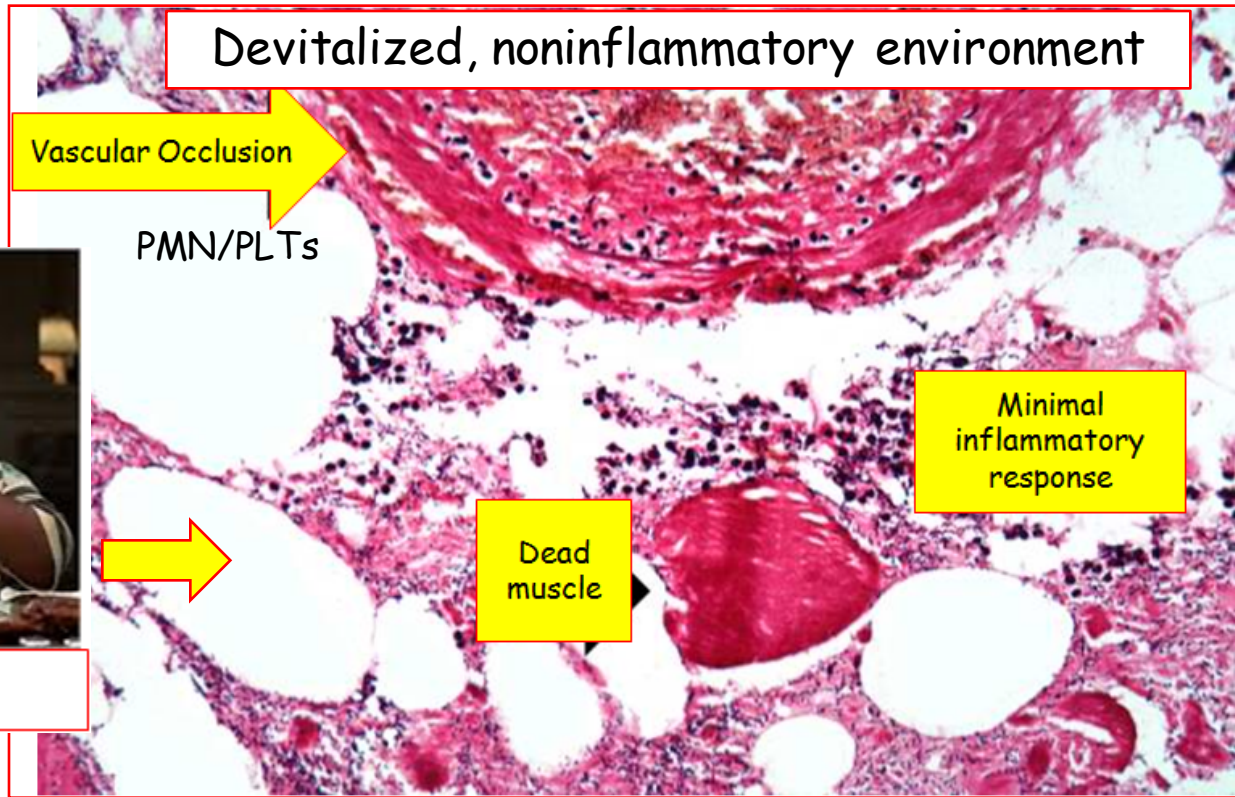
PMN/PLTs

Minimal inflammatory response

Dead muscle



My baby's got gas!



# Clostridium perfringens

## (Gas Myonecrosis)

- Clinical

- Severe pain at site of trauma (due to tissue ischemia)

- PE (skin):

**α-toxin**

- **Crepitus** may be present (most characteristic); **bronze** color/discharge

- Large **bullous** vesicles that easily rupture

- Systemic toxicity (shock) occurs early (fever, multiorgan dysfunction)

- Diagnosis

- Gas on imaging

- Blood/tissue cultures with presence of **Gram (+) rods but no pus** (or PMN on microscopy)

- Treatment

- (Repeated) Surgical debridement, antibiotic (PCN plus Clindamycin), shock support, hyperbaric oxygen (?)

# Clostridium perfringens

(Gas Myonecrosis)

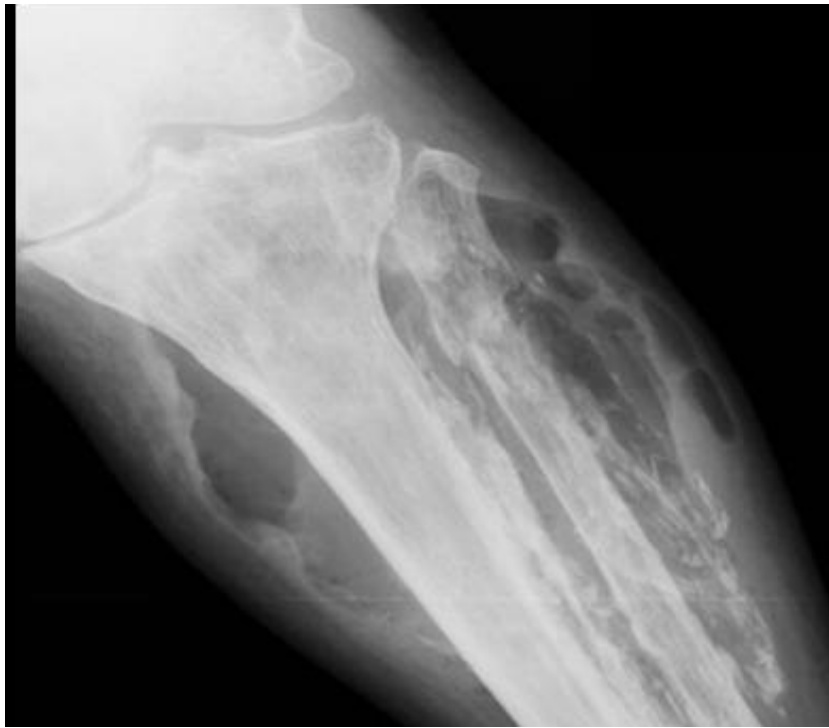
They describe a patient with gas myonecrosis and then inquire about other syndrome caused by this organism...

the bait and switch

- **Special Notes:**

- May also cause **a syndrome of watery diarrhea** with spores germinating (in gut); source: meat, poultry or gravy.
- Heat stable enterotoxin is produced in the GI tract after ingestion.
- Symptom delay (unlike ingestion of bacillus and staph toxins)





Clostridium perfringens: spore forming, anaerobic [gram \(+\) rod](#)

1. Traumatic injury
2. Crepitus +/- Shock
3. **Toxin:**  $\alpha$ -toxin (aka Phospholipase C, Lecithinase).
  - Destroys cell membrane (catalyzes splitting of PPL molecules) AND
  - Vascular occlusion (PMN and platelet aggregates w/o inflammatory response)
4. **GI illness: watery diarrhea (enterotoxin-mediated)**



# Necrotizing Fasciitis

- Background
  - Fulminant soft tissue destruction w/ shock-like presentation
    - Muscle **fascia** and subcutaneous **fat** (c/w myonecrosis)

Similar shock-like presentation to myonecrosis

Different organism - ***S. pyogenes***

Different tissue - **fascia/fat**

No gas present - **aerobic**

(if crepitus or gas → *C. perfringens*)



Necrotizing  
Fasciitis

# Necrotizing Fasciitis

- Background
  - Fulminant soft tissue destruction w/ shock-like presentation
    - Muscle **fascia** and subcutaneous **fat** (c/w myonecrosis)
  - Infections may be mono- (**GAS**, SA) or polymicrobial.
    - Tissue injury → monomicrobial; Diabetes → polymicrobial
- Microbiology
  - GAS (Strep pyogenes): catalase negative, bacitracin sensitive (PYR +).
  - Key Virulence Factors:
    - M protein - antiphagocytic (blocks opsonization)
    - Pyrogenic exotoxins - superantigens associated with TSS
- Gross Pathology
  - Initial spread along fascial planes; **the overlying tissue may appear to unaffected.**

# Necrotizing Fasciitis

- Clinical

- Fever and systemic signs of toxicity (multi-organ failure)
- Pain out of proportion to physical findings (swelling, warmth)
- Progresses over 3-5 days w/o  $\Delta$  in overlying soft tissue (may appear unaffected)
  - Pain may improve due to involvement of blood vessels (thrombosis) and extension to nerves (akin to thrombangiitis obliterans)
- Swelling may lead to compartment syndrome with progression → myonecrosis

- Diagnosis: **Surgical Visualization**

- There are no diagnostic tests. Studies: oriented toward systemic manifestations of infection and assessing for gas in compartments
  - Blood/Wound (intraoperative) cultures, CBC, CPK, BUN/Cr; Imaging?

- Treatment

- **Surgical** debridement and antimicrobials (poly- or monomicrobial coverage)
  - Mortality rate w/o surgery: ~100%

- Special Notes

- Distinguishing from myonecrosis and identification of responsible organisms is determined via surgery and histopathology.



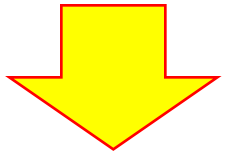
GAS, catalase neg  
Bacitracin (S), PYR (+)



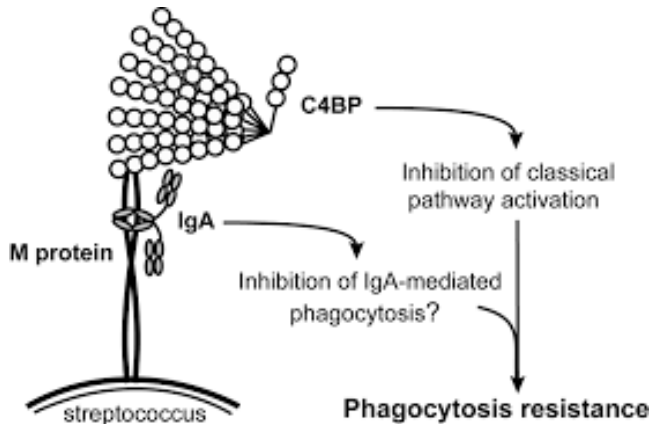
The Flesh Eaters:  
Necrotizing Fasciitis



Pain out of proportion to  
physical findings



M-protein: immunogenic, anti $\Phi$



Fascia and Fat

If gas, think clostridia

