

Anaerobic infection

Gas gangrene

Anaerobic bacteria

- **Anaerobic bacteria are the most numerous inhabitants of the normal gastrointestinal tract, including the mouth**
- **Bacteroides fragilis and Clostridium**
- **The most common anaerobic isolate from surgical infections is Bacteroides fragilis**

Bacteroides fragilis:

- have significant resistance to many β -lactam antibiotics
- most effective antibiotics against these species are metronidazole, clindamycin, meropenem and sulperazon

Clostridium:

- The Clostridium species are all gram-positive, spore-forming encapsulated rods.
- C. Perfringens
- C. Septicum
- C. histolyticum

- These strains grow only in settings with a low oxidation-reduction potential.
- Thus, the recovery of anaerobes from a soft tissue infection or even from the blood implies their growth and multiplication in a focus of dead tissue.

Necrotizing Fasciitis



- This disease usually occurs in men in the lower extremities after only minimal local trauma.
- Although a monobacterial etiology, typically *Clostridium* and *Streptococcus* group A, can be found, the infections are usually produced by mixed flora, both aerobes and anaerobes.

Necrotizing Fasciitis

Pathogenesis

A substance in the cell wall of streptococci causes:

- separation of the dermal connective tissue, resulting in continued inflammation and necrosis.
- tissue ischemia by widespread occlusion of small subcutaneous vessels.
- Vessel occlusion results in skin infarction and necrosis, which facilitates the growth of obligate anaerobes while promoting anaerobic metabolism by facultative organisms (eg, *Escherichia coli*), resulting in gangrene.
- Anaerobic metabolism produces hydrogen and nitrogen, relatively insoluble gases that may accumulate in subcutaneous tissues

Necrotizing Fasciitis

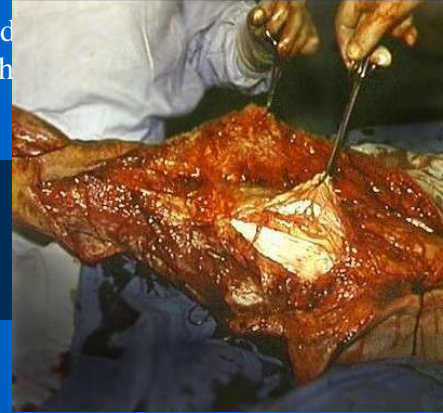
Signs

- **Streptococcal necrotizing fasciitis is frequently associated with streptococcal toxic shock syndrome.**
- **Early clinical findings are similar to those with most infected wounds, but the involved site quickly becomes erythematous, tender, and edematous; fever is usually present.**
- **Deep pain is often out of proportion to the physical findings.**

Necrotizing Fasciitis

Signs

- **Bullae, crepitus (from soft-tissue gas), and gangrene may develop.**
- **Subcutaneous tissues (including adjacent fascia) necrose. Deep structures and muscles are not involved.**
- **Hypotension, tachycardia, leukocytosis, with systemic toxicity out of proportion to the clinical findings.**



Treatment

- Treatment involves antibiotics and surgical debridement.
- The initial incision should be extended until an instrument or finger can no longer separate the skin and subcutaneous tissue from the deep fascia.
- The most common error is insufficient surgical intervention
- Amputation of an extremity may be necessary.
- Fluids may be needed in large volumes before and after surgery.
- Antibiotic choices should be reviewed based on Gram stain and culture of tissues obtained during surgery.
- Hyperbaric O₂ therapy may also be of benefit
- Prognosis is poor without early, aggressive treatment.

Treatment of n

- Treatment involves a debridement.
- The initial incision should be made with a scalpel or instrument or finger can be used to separate subcutaneous tissue from the underlying structures.
- The most common error is to perform a wide debridement.
- Amputation of an extremity may be necessary.
- Fluids may be needed during surgery.
- Antibiotic choices should be based on the Gram stain and culture of tissues obtained during surgery.
- Hyperbaric O₂ therapy may also be of benefit.
- Prognosis is poor without early, aggressive treatment.



Cellulitis

- **Nonclostridial**
- **Clostridial**



Cellulitis Etiology

- Cellulitis is most often caused by aerobic and anaerobic coliforms such as *E. coli*, *Klebsiella*, *Enterobacter*, *Peptostreptococcus*, *Peptococcus*, and *B. fragilis*, group A β -hemolytic streptococci or *Staphylococcus aureus*.
- Streptococci cause diffuse, rapidly spreading infection because enzymes produced by the organism (streptokinase, hyaluronidase) break down cellular components.
- Staphylococcal cellulitis is typically more localized and usually occurs in open wounds or cutaneous abscesses.

Cellulitis Etiology

- **Recently, methicillin-resistant *S. aureus* (MRSA) has become more common in the community.**
- **Historically, MRSA was typically confined to patients who were exposed to the organism in a hospital or nursing facility.**
- **MRSA infection should now be considered in patients with community-acquired cellulitis, particularly in those with cellulitis that is recurrent or unresponsive to monotherapy.**

Symptoms and Signs

- **Infection is most common in the lower extremities. Cellulitis is typically unilateral.**
- **The major findings are local erythema and tenderness, frequently with lymphangitis and regional lymphadenopathy.**
- **The skin is hot, red, and edematous, often with surface appearance resembling the skin of an orange.**
- **The borders are usually indistinct.**
- **Vesicles and bullae may develop with necrosis of the involved skin.**
- **Fever, chills, tachycardia, headache, hypotension, and delirium may precede cutaneous findings by several hours, but many patients do not appear ill.**
- **Leukocytosis is common.**

Cellulitis treatment

- **Risk factors include skin abnormalities (eg, trauma, ulceration, fungal infection, other skin barrier compromise due to preexisting skin disease), which are common in patients with chronic venous insufficiency or lymphedema**
- **These infections tend to progress from a fasciitis to a myositis.**
- **The treatment is broad-spectrum antibiotics and close observation and debridement**

Clostridial cellulitis



- Clostridial cellulitis (anaerobic cellulitis, local gas gangrene) is a gas-forming infection of the skin and subcutaneous tissue that spreads through intrafascial planes.
- Healthy muscle is not involved. It results from superinfection of previously traumatized or necrotic tissue.
- Gas distributes in large bubbles in the fascial plane but not the muscle.
- Patients show signs of systemic toxicity: fever, tachycardia, edema of the affected part, and pain.
- Incision and debridement of involved tissue and blebs are necessary.

Fournier's syndrome

- is a necrotizing subcutaneous infection of the perineum that occurs primarily in men, usually involving scrotum.
- Pain or itching in the genitalia is followed by fever, chills, and impressive perineal swelling, which may simulate a strangulated hernia.
- The inflammation may involve the entire abdomen, back, and thighs.
- There is frequently crepitance on palpation, indicating subcutaneous gas.
- Systemic symptoms include nausea and vomiting
- The most common causal factors are infection or trauma to the perianal area, including anal intercourse, scratches, chemical or thermal injury, and diabetes.

Fournier's syndrome Management

- **wide incision and drainage of the area to remove all the necrotic tissue.**
- **Gram's stain and culturing of the wound, antibiotic therapy against anaerobes and gram-negative enterics**

Clostridial myonecrosis, or gas gangrene



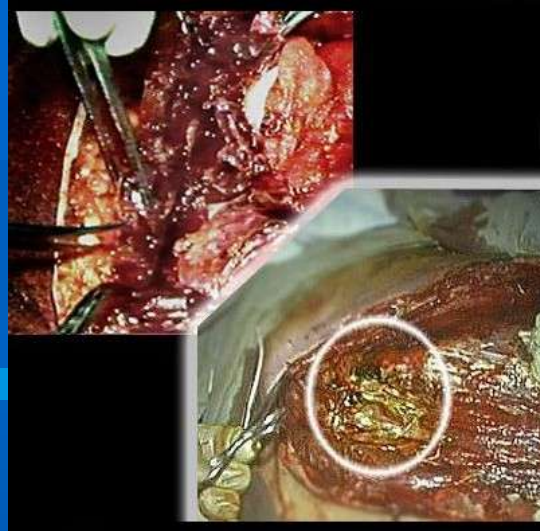
- Myonecrosis, is a deep soft tissue infection with death of muscle and a variable degree of inflammation of the overlying tissues.
- The skin may show minimal erythema, but usually the infection is associated with massive edema, with gas formation.
- It is usually a result of trauma or recent surgical wounds.

Pathogenesis



- Pathogenesis includes the elaboration of exotoxins by Clostridial bacilli.
- Clostridia produce a toxin that damages and kills muscle, setting up the anaerobic environment that promotes further growth of the bacilli.
- The incubation period is 1 to 4 days.
- The patient appears pale and anxious, with a rapid progression to toxemia and shock.

Signs



- The wound becomes painful and markedly swollen, and within hours a brownish, thin exudate develops, with crepitus in the surrounding tissue.
- A brownish skin discoloration may appear and progress with the development of purplish blebs.
- An odor described as “sickly sweet” is evident, and the patient becomes anuric.
- The muscle appears to be cooked or dead and does not bleed when cut or retract when pinched.

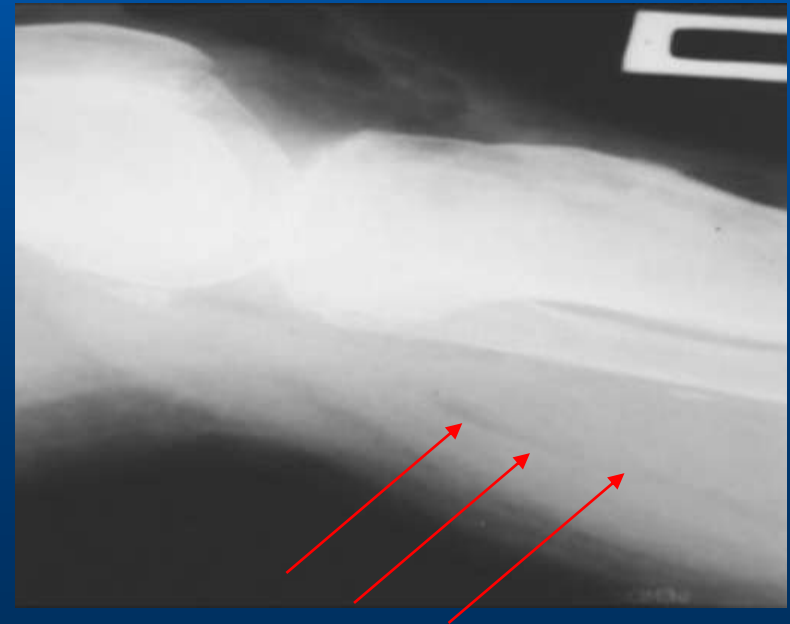
Clostridial myonecrosis

- Specially placed tight control bandage leaves a mark on the skin after removal and the sutures seem to be «cutting through» the skin



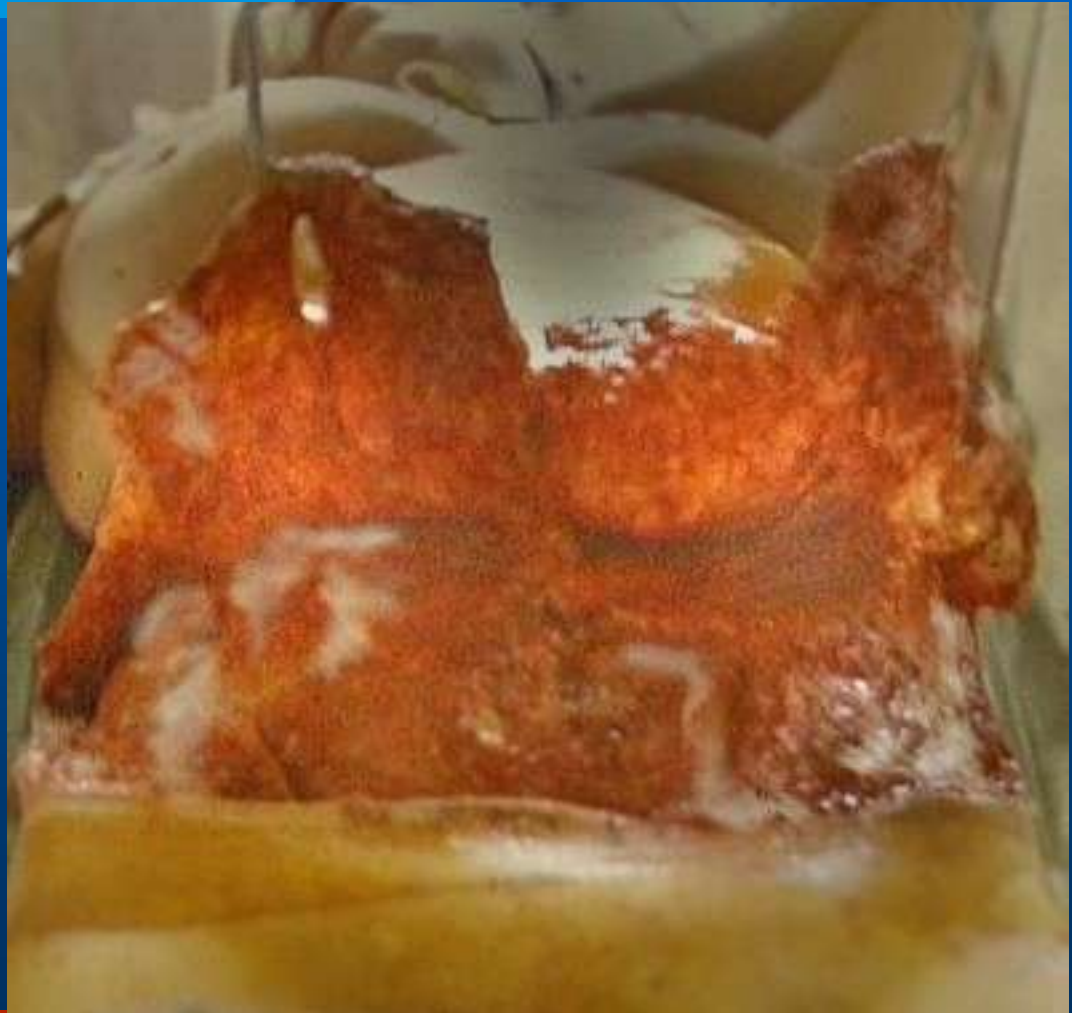
Clostridial myonecrosis Diagnostic

- Gram's stain smears of the area show large gram-positive rods. Radiographs may reveal gas.



Clostridial myonecrosis Treatment

**Treatment is
wide
debridement
and excision of
the wound.**



antibiotic

- Parenteral antibiotics should be given to cover anaerobes and enterics:
- a cephalosporin, carbopenem, vancomycin, metronidazol and dioxidin is indicated.
- The mortality rate is high



Hyperbaric oxygen therapy



- Abacterial Atmosphere and
- Hyperbaric oxygen therapy (HBO) may be effective very early in this disease.
- HBO does not kill clostridia; it has a bacteriostatic effect, and oxygen will inhibit α -toxin production.

After operation

