

Genus Clostridium



General characteristics

- The clostridia are large, anaerobic, gram positive spore forming bacilli.
- The organisms are ubiquitous in soil, water, and sewage, and are part of the normal flora in the gastrointestinal tracts (GIT) of humans and animals.
- About 177 species have been identified, but most of the clinically important isolates fall within a few species.
- Spores of clostridia are usually wider than the diameter of the rods in which they are formed, and in different species, the spores is placed centrally, subterminally, or at the terminal ends.
- There are motile and non motile species. The motils species with peritrichous flagella.
- Most species are obligate anaerobes, but there is a degree of oxygen tolerance that some species as *C. tertium* being able to grow in air.

Cultural characteristics

- Clostridia grow well on the blood agar in anaerobic condition.

- Other media used for anaerobic growth are: cooked meat medium, sodium thioglycolate, and litmus milk.
- Some clostridia produce large raised colonies (e.g. *C. perfringens*), others produce smaller colonies (e.g. *C. tetani*), some form colonies that spread on the agar surface.
- Many clostridia produce a zone of hemolysis on blood agar.

Methods of classification of Clostridia

1. Morphological features The shape and position of spores
2. Biochemical features Saccharolytic and proteolytic capacities
3. Disease syndromes

Group I: gas gangrene exp.

C. welchii (perfringens), *C. septicum*, *C. oedematiens* (Novyi)

(They are invasive and cause septicemia)

Group II: Tetanus

C. tetani (slightly invasive)

Group III: Botulism

C. Botulinum (non-invasive)

Group IV: Pseudomembranous colitis *C. difficile*

Group V: Miscellaneous

Gangrenous appendicitis, brain abscess, meningitis, biliary tract infection, wound infection, and pneumonia.

***Clostridium Perfringens* (welchii)**

The main characteristics

- The spores are found in soil, dust and GIT of human and animals, but rarely seen in the laboratory culture.
- Gram positive, anaerobic bacilli, but may grow microaerobically, about $4-6\mu \times 1\mu$
- Capsulated, non motile, and the optimum temp. for many species is 45°C .
- Shows double zone of hemolysis on blood agar.
- Can produce invasive infection (including myonecrosis and gas gangrene) if introduced into damaged tissue.
- The production of one or more lethal toxin by *C.perfringens* (alpha (α), beta (β), epsilon (ξ), and Iota (1)) is used to subdivide the isolates of *C.perfringens* in to 5 types (A-E).
- Type A *C.perfringens* causes most of the human infections which produce large amount of α -toxin.
- α -toxin is a lecithinase (phospholipase) that lyses erythrocytes, platelets, leucocytes and endothelial cells.
- Enterotoxin of *C.perfringens* (produced primarily by type A strains) is a common cause of food poisoning which is characterized by diarrhoea without fever or vomiting (this illness is similar to that produce by *B.cereus* and is self limited).

Clinical diseases

I- Gas gangrene

- Develop in traumatic wounds with muscle damage when they are contaminated with foreign material containing *C.perfringens* or other species of histotoxic clostridia, also occur in contaminated wound in post partum uterus.
- The infection spreads in 1-3 days to produce crepitation in the subcutaneous tissues and muscle.
- Foul-smelling discharge, rapidly progressing necrosis, fever, hemolysis, toxemia, shock and death if untreated.
- The disease gas gangrene is a medical emergency and mortality rate is high.

Pathogenesis

The microorganism grows in traumatized tissues and produce:

- a- Toxins specially α -toxin which damage cell membrane including RBCs resulting in haemolysis.
- b- Degradative enzymes (collaginase and hyalluronidase).
- c- Production of gas (H_2) as a result of CHO fermentation in tissues.

Laboratory diagnosis

1. Diagnosis of gas gangrene is based ultimately on clinical observation as the organism contaminate the wounds.

2. Haematological investigation:

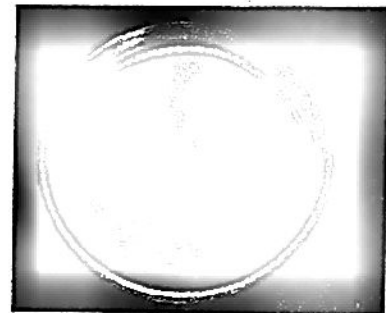
anemia, increased serum bilirubin and haemoglobinurea which is due to excessive RBC destruction.

3. bacteriological tests: the presence of large gram positive rods in gram-stained smears in specimen taken from wound, pus, or tissue suggest gas gangrene clostridia.

4. Culture of the specimens on cooked meat, blood agar or thioglycolate media. The microorganism rarely produce spores when cultured on agar in the laboratory.

5. Identification of *C.perfringens*

- Haemolysis on blood agar +ve



- Fermentation reactions

- Lecithinase activity is evaluated by the precipitate formed around colonies on egg yolk media (Nagler's reaction +ve).

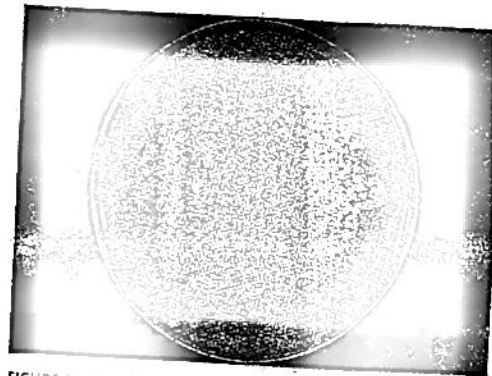


FIGURE 40-3. Growth of *Clostridium perfringens* on egg-yolk agar. The α -toxin (lecithinase) hydrolyzes phospholipids in serum and egg yolk, producing an opaque precipitate (right). This precipitate is not observed when the organism is grown in the presence of antibodies against the toxin (left). This reaction (Nagler's reaction) is characteristic of *C. perfringens*.

- Animal pathogenicity.
- Toxin production and neutralization by specific antitoxin.

Other clostridial species associated with gas gangrenes

C.septicum, C.oedematines, C.histolyticum

II- Food poisoning

- The spores of some *C.perfringens* strains are heat resistant and can withstand temperature of 100°C.
- *C.perfringens* food poisoning usually follows the ingestion of large numbers (more than 10^5 per gram) of the microorganism that have grown in warmed meat dishes.
- The enterotoxin forms when the organisms sporulate in the gut. It is released in the upper GIT, causing a fluid output in which the ileum is most severely involved.
- The incubation period of 8-24 hours is followed by nausea, abdominal pain and diarrhoea.
- There is no fever.
- Spontaneous recovery usually occurs within 24 hrs.

III- Necrotizing bowel disease

- Caused by type A and C
- More serious than food poisoning.

- It is painful with abdominal cramps, vomiting, bloody diarrhoea, acute inflammation, necrosis, and shock.
- Incubation period 10-24 hrs.
- Enterotoxin-producing *C.perfringens* can also be responsible for outbreak of antibiotic associated diarrhoea appears very similar to that caused by *C.difficile*.

IV- Endometritis

- When *C.perfringens* gain access to necrotic products in the uterus, they multiply and infect the endometrium.
- Necrosis of uterine tissue and septicemia with intravascular haemolysis due to α toxin may occur.

V- Anaerobic cellulitis

- Infection of the wounds and surrounding subcutaneous tissue.
- There is a marked gas formation (more than in gas gangrene), but no pain, no swelling, and no toxicity as gas gangrene.
- This condition is less serious than gas gangrene.

Treatment

1. The important aspect of treatment is prompt and extensive surgical debridement of the involved area.
2. Administration of antimicrobial drugs, mainly penicillin (is begun at the same time).
3. Placement of patients in hyperbaric oxygen chamber.

Prevention and control

- Early and adequate cleaning of contaminated wounds and surgical debridement, together with the administration of antimicrobial drugs.
- Good cooking and adequate refrigeration.

Clostridium oedematiens (novyi)

- Typically large gram positive bacilli, with oval, central, or subterminal spores.
- Extremely strict anaerobes.
- Four types A-D present. Type A strains are associated with wound and soft tissue infections causing gas gangrene characterized by high mortality rate.
- It is a rare member of faecal flora of human.

Clostridium septicum

- It is found in polymicrobial infection in gas gangrenes and in systemic infections associated with malignancies or immunosuppression where it has a variable clinical presentation and is associated with a high mortality.
- It is spore forming, but the spores within the diameter of the rods.

