

## Gram Positive Bacilli

(Spore Forming)

A- Strict aerobic – Genus *Bacillus*.

B- Strict anaerobic – Genus *Clostridium*.

*Bacillus* species

Spore forming gram positive strict aerobic capsulated bacilli, arranged in long chains; spores may central, subterminal or terminal, depending on the species.

Most members are saprophytic prevalent in soil, water, air and vegetation such *Bacillus cereus*, and *Bacillus subtilis*. Some are insect pathogens

### *Bacillus anthracis*

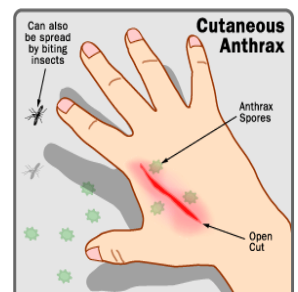
The anthrax bacilli, (*B. anthracis*), was the first bacterium shown to be the cause of a disease. In 1877, Robert Koch grew the organism in pure culture, demonstrated its ability to form endospores, and produced experimental anthrax by injecting it into animals.

*B. anthracis* cause the disease Anthrax in animals in which the organism is transmitted through eating vegetations containing the spores. Human is infected through contact with animals or their products.

### Type of clinical infection

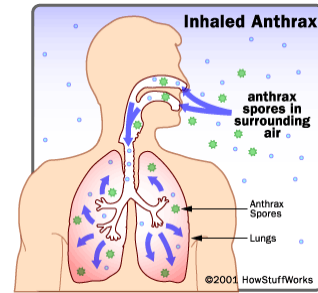
A- **Cutaneous Anthrax** (malignant pustule)

Generally occurs on exposed surfaces of the arms, face and neck through wound contamination by the spores of the organism. About 95% of the cases with a mortality rate 20%.



### **Inhalation Anthrax** (wool sorter disease)

About 5% of the cases with 85–90% mortality.



C- **Gastrointestinal Anthrax**: Is very rare.



### Laboratory Diagnoses

**Specimen:** Aspirate or swab from cutaneous lesion, Fluid, pus, blood, sputum.

**Gram stain.**

Culture on blood agar and chocolate agar, animal inoculation and by detecting of antigen in the infected tissues.

### Treatment

Penicillin and ciprofloxacin are the drug of choice. In case of penicillin allergy, erythromycin, doxycycline, Tetracycline, chloramphenicol, Erythromycin, Clindamycin may be used.

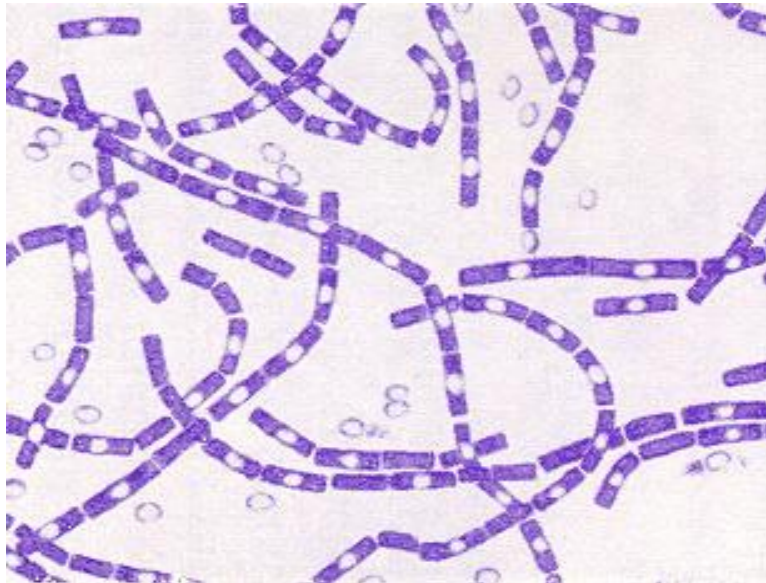
### Prevention

- Vaccination of animal herds
- Proper disposal of carcasses

*Bacillus cereus*

Cause food poisoning :Two types

- 1- Emetic type associated with fried rice.
- 2- Diarrheal type associated with meat dishes and sauces



***Bacillus anthracis*. Gram stain.**

The cells have characteristic squared ends. The endospores are ellipsoidal shaped and located centrally in the sporangium.

## Clostridium Species

Large anaerobic gram positive, spore forming, motile rods. Many decompose protein or form toxins and some do both. Their natural habitat is the soil or the intestinal tract of human and animals, where they live as saprophytes. Among the pathogens are the organisms causing:

- 1- Botulism
- 2- Tetanus
- 3- Gas gangrene
- 4- Pseudomembranous colitis.

### Morphology and Identification of Clostridium Species

Spores of clostridia are usually wider than the diameter of the rods in which they are formed.

In most species, the spores are located centrally, subterminally or terminally. Most species of Clostridia are motile with peritrichous flagella.

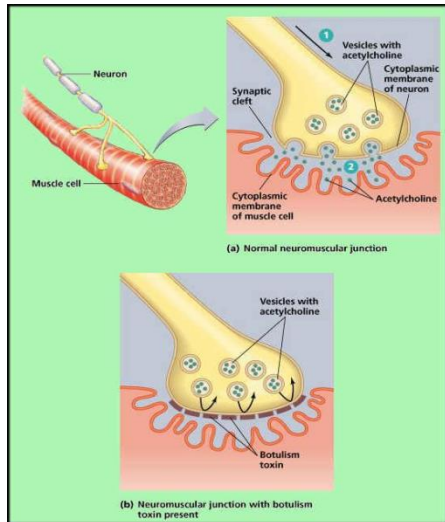
### *Clostridium botulinum*

**Causes botulism**, found in soil and occasionally in animal faeces.

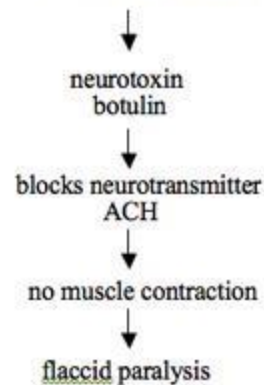
**Toxins:** Seven varieties (A-G).

### Pathogenesis

**Clinical Finding:** Symptoms begin 18-24 hours after ingestion of the toxic food. GI symptoms are not regularly prominent. No fever, with visual disturbances, inability to swallow and speech difficulty, paralysis and death due to respiratory paralysis or cardiac arrest.



### *Clostridium botulinum*



## Diagnosis

It may be possible demonstrate Gram positive, sporing bacilli in faeces, food, vomitus and other samples.

## Treatment and prevention

Supportive therapy is important. Proper preservation and canning of food play a very significant role in preventing botulism.

During an outbreak, a prophylactic dose of antitoxin should be administered to all those who consumed the suspected food articles.

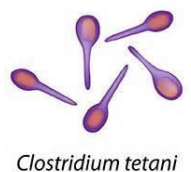
### *Clostridium tetani*

**Causes Tetanus**, worldwide in distribution in the soil and in the faeces of horses and other animals.

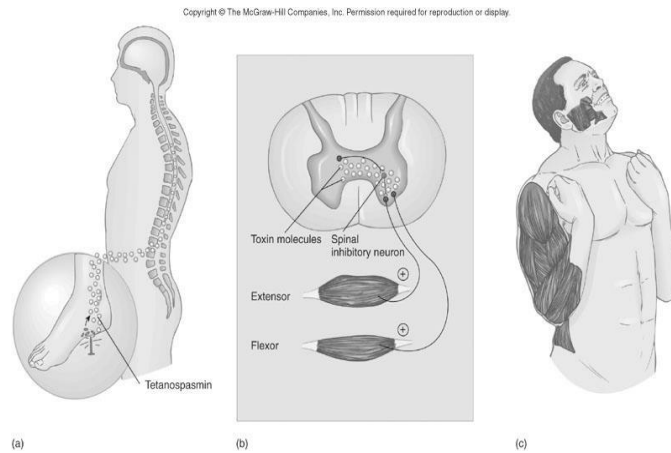
**Toxins:** Tetanospasmin

## Pathogenesis

Wound contamination with bacteria lead to toxins release from vegetative cells reach the CNS and rapidly becomes fixed to receptors in the spinal cord and brain stem and exerts their action.



**Clinical Findings:** Incubation period: 4–5 days to many weeks. The disease is characterized by tonic contraction of voluntary muscles (muscles spasm).



## Diagnosis

Diagnosis of tetanus is basically clinical although, one can demonstrate *C. tetani* by microscope, culture or by animal inoculation of the bacterial toxin.

## Treatment and prevention

It is important to control spasm and maintain airway and nutrition. ATS (antitetanus serum) may be administered to neutralize the toxin.

Neonatal tetanus can be prevented by immunizing the pregnant mother with two doses of tetanus toxoid and following by clean delivery practices.

## *Clostridium perfringens*

### (Clostridia Invasive Infections)

Many different toxin producing clostridia can produce invasive infections (including myonecrosis and gas gangrene), if introduced into damaged tissue. About 30 species of clostridia may produce such an

infection, but the most common in invasive disease is *C. perfringens* (90%). An enterotoxin of *C. perfringens* is a common cause of food poisoning.

**Toxins:** produce different types of toxins and enzymes that result in spreading infection. They have lethal, necrotizing, and hemolytic properties.

**Pathogenesis:** Wound contamination.

**Clinical Findings:** Infection spreads in 1–3 days. Crepitation in subcutaneous tissue and muscle, fever, tissue necrosis, hemolytic anemia, severe toxemia and death.

### Diagnosis

Although the diagnosis is clinical, laboratory confirmation is based on microscopy, culture, demonstration of toxigenic characters and less often, by animal pathogenicity testing.

### Treatment and prevention

Penicillin G is the drug of choice, although metronidazole can be used effectively. Antibiotics are accompanied by aggressive surgical debridement and drainage along with the administration of hyperbaric oxygen.

## *Clostridium difficile*

Pseudomembranous colitis (Antibiotic – Associated Diarrhea).

It is a typical gram positive rod with subterminal spores. This bacteria produce at least two toxins: cytotoxin B, which is cytopathic for most tissue culture cell lines, and enterotoxin A, which promotes fluid

secretion and destroy intestinal lining cells. The colitis is due to the active multiplication of *Clostridium difficile* and the production of enterotoxin.

### Pathogenesis

Colitis that is caused by *C. difficile*, with or without membrane formation, is a complication of antibiotic therapy. Most often, beta-lactam agents, lincomycin and clindamycin are implicated.

### Diagnosis

*C. difficile* can be isolated from the stool of the patients or by demonstrating the toxin in the faeces of the patients.

### Treatment and prevention

Restricting the use of clindamycin and lincomycin may help since they are particularly prone to cause colitis.

Oral vancomycin and metronidazole are used to treat *C. difficile* colitis.