

Anaerobic Bacteria: Clostridium Species (Clostridium tetani)

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Learning Objectives

After studying this topics, students will be able to:

- **Describe pathogenesis of tetanus.**
- **Describe Clinical features of tetanus.**
- **Describe Prevention of tetanus.**

CLOSTRIDIUM

Genus Features

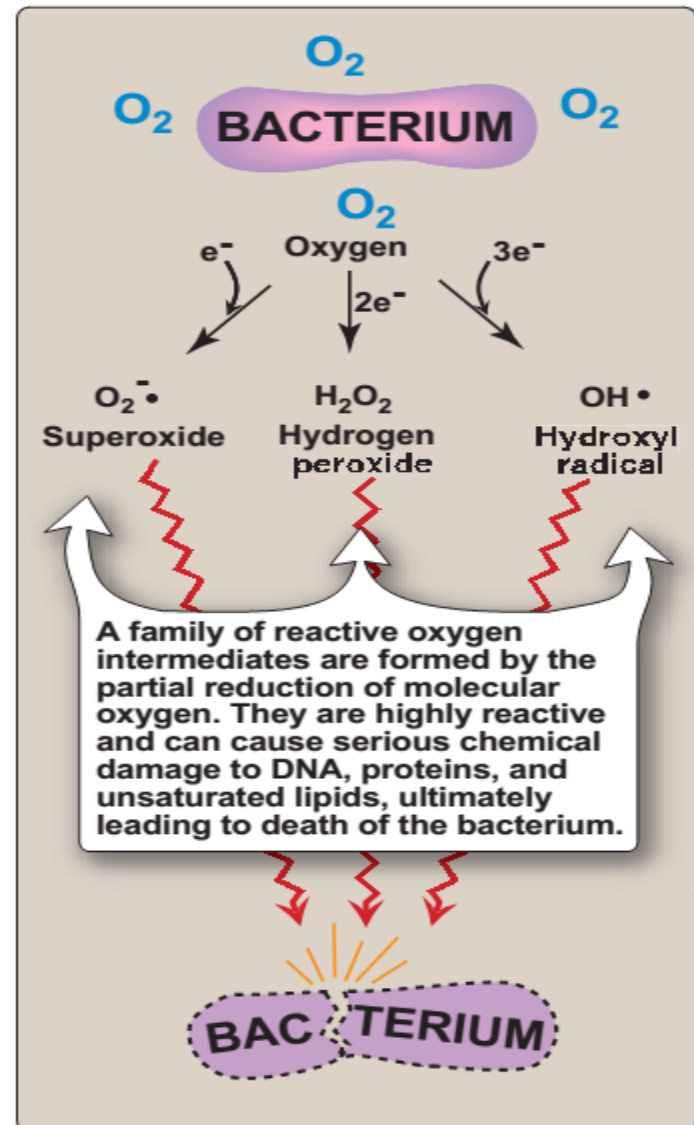
**Gram-positive
rods**

Spore forming

**Obligate
anaerobe**

Obligate anaerobes

- Cannot grow in presence of oxygen
- completely lack superoxide dismutase and catalase
- susceptible to the lethal effects of oxygen



Clostridium:-Habitat

Clostridia are saprophytes

found in:-

soil, marine sediments,

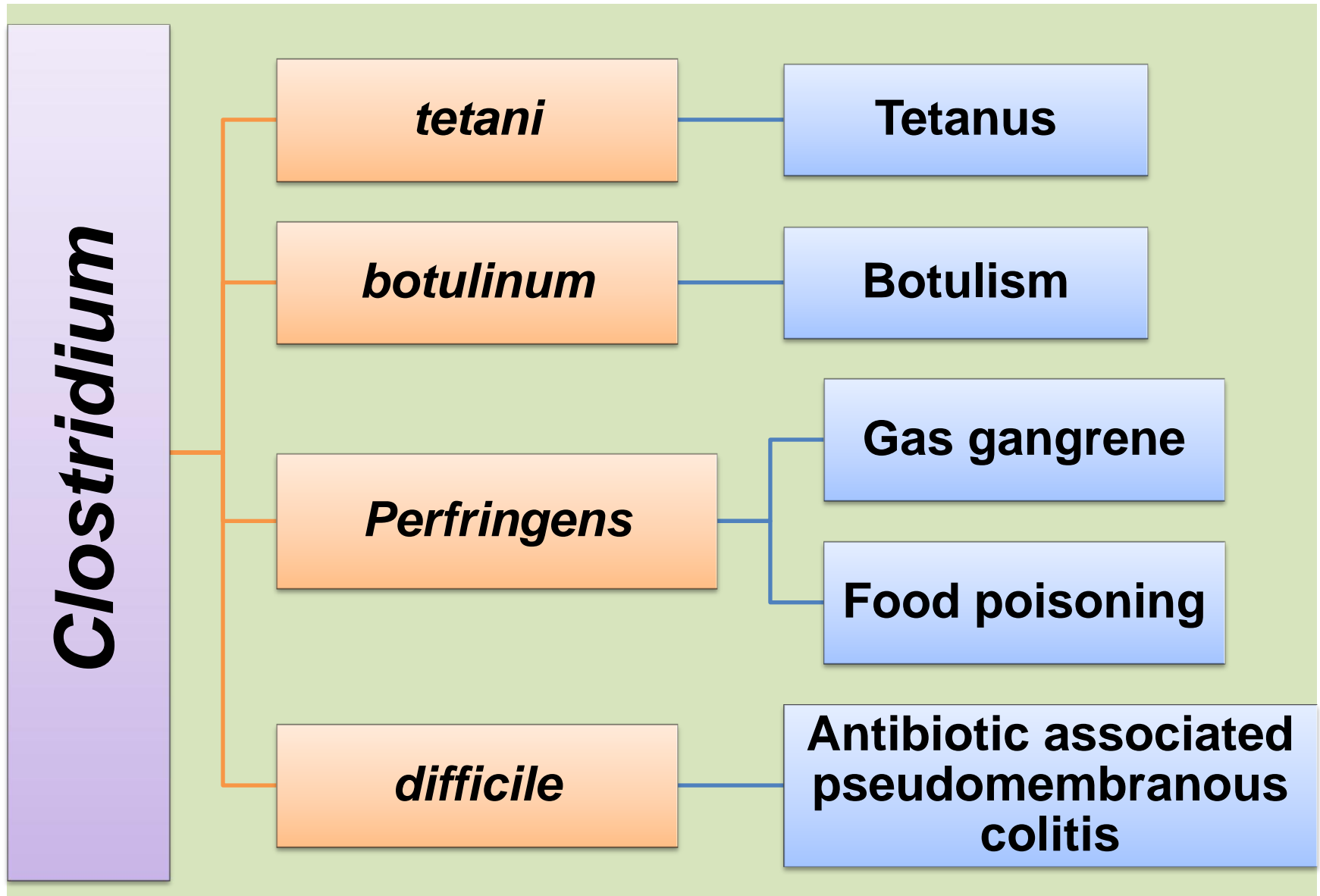
sewage, or the intestinal

tract of animals and

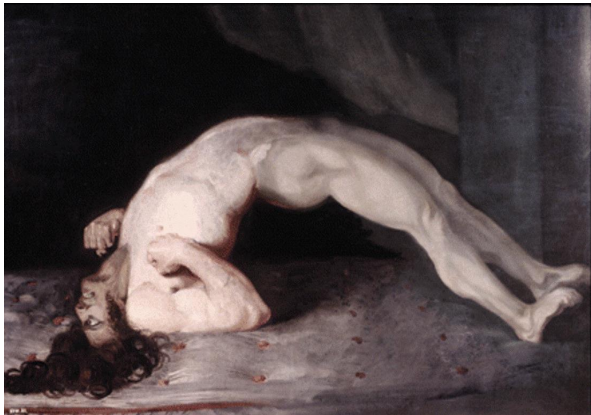
humans.



Species of Medical Importance



Spastic paralysis



Tetanus



Botulism

Flaccid paralysis



Gas gangrene



Pseudomembranous colitis

Clostridium tetani



Clostridium Tetani

Clostridium

Tetani

Produce O₂ Exotoxin

 Tetanospasmin

Tetanolysin

Obligate anaerobe

gram-positive

spore-forming rods

Other three *Clostridium* spp. bear sub-terminal spores

Spore is at one end ("terminal spore"),

Drum stick appearance



Subterminal spores
(e.g. *Clostridium perfringens*)



Spherical and terminal spores
(e.g. *Clostridium tetani*)

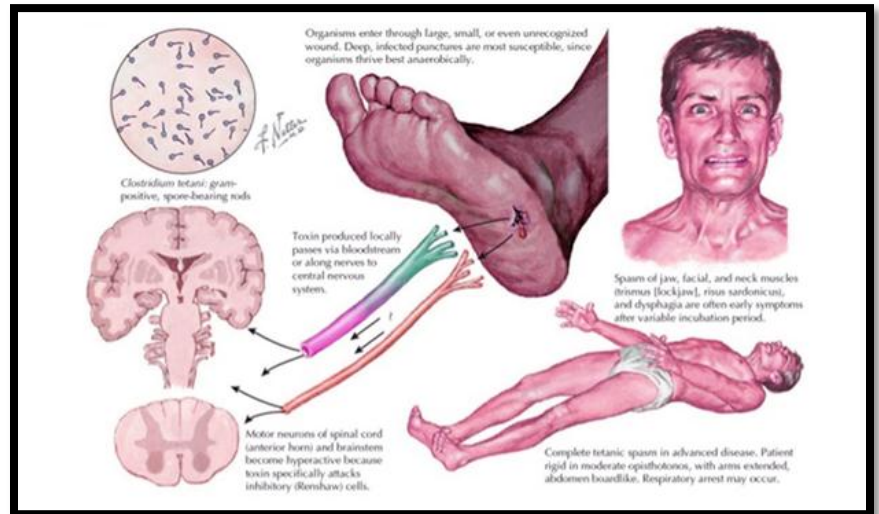
Clostridium tetani-Virulence Factors

Tetanolysin is a heat labile, oxygen labile hemolysin. It plays no role in the pathogenesis.

Tetanospasmin or tetanus toxin (TT) is a neurotoxin responsible for the pathogenesis of tetanus. It is oxygen stable but heat labile.

Tetanus

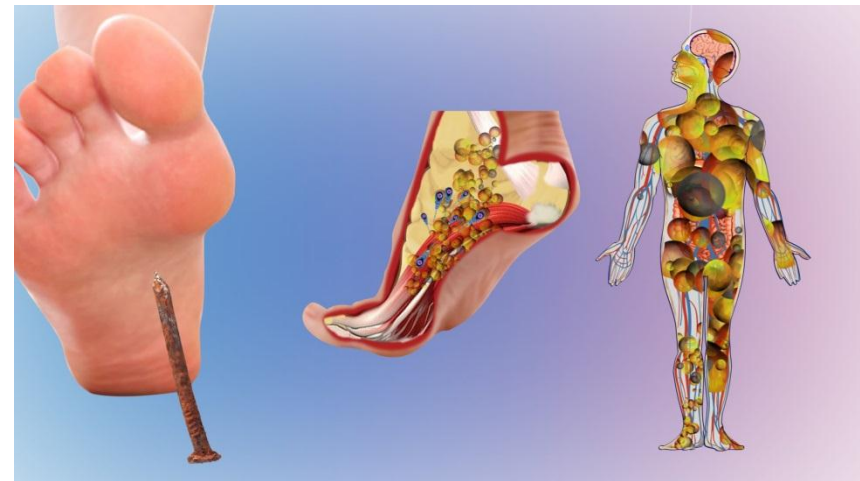
- An acute disease.
- manifested by **skeletal muscle spasm** and autonomic nervous system disturbance.



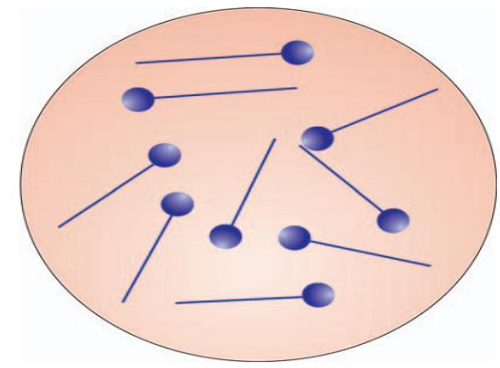
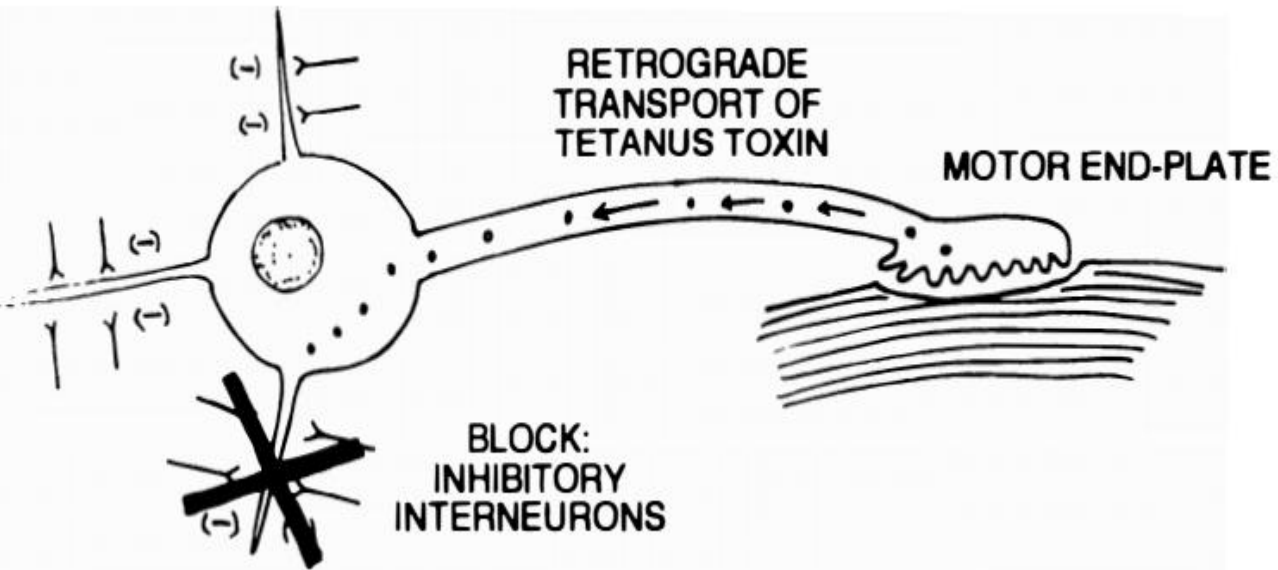
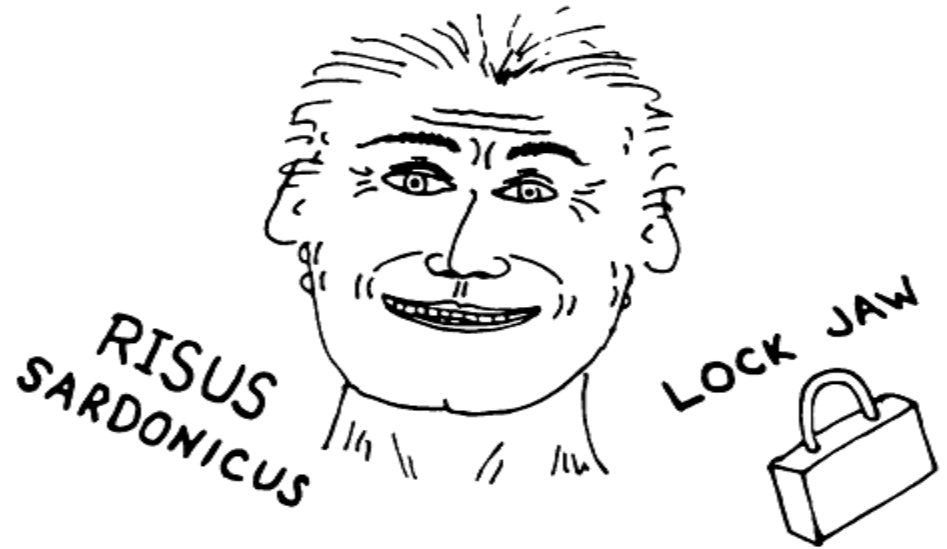
Mode of Transmission

Tetanus bacilli enter through:

- Injury {superficial abrasions, punctured wounds, road traffic accidents).
- Surgery done without proper asepsis
- Neonatal tetanus-organism enters through a contaminated umbilicus or circumcision wound



Pathogenesis of Tetanus



Wounds contaminated with spores of *C.tetani*.

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graph TD; A[Wounds contaminated with spores of C.tetani.] --> B[Spore germinate to vegetative form under anaerobic condition.]; B --> C[Presence of necrotic tissue, Ca salt, infection by other aerobic bacteria produce anaerobic condition and favours germination of spores.]; C --> D[Vegetative bacteria multiply and liberate a potent neurotoxin- tetanospasmin.]; D --> E[From the local wound site toxin is absorbed through the motor nerve terminals and reaches the cell body(Neuron) in the CNS via retrograde axonal transport.];
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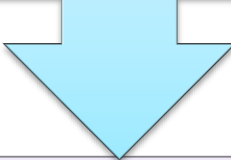
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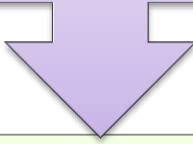
Vegetative bacteria multiply and liberate a potent neurotoxin- **tetanospasmin.**

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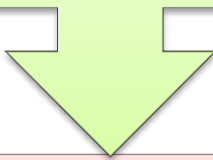
Tetanospasmin rapidly binds with the ganglioside receptors at the pre synaptic membrane of the neurons which secrete inhibitory neurotransmitter- **Glycin or GABA.**



The toxin diffuses to terminals of inhibitory cells, including GABA and glycine producing inhibitory neuron terminals.

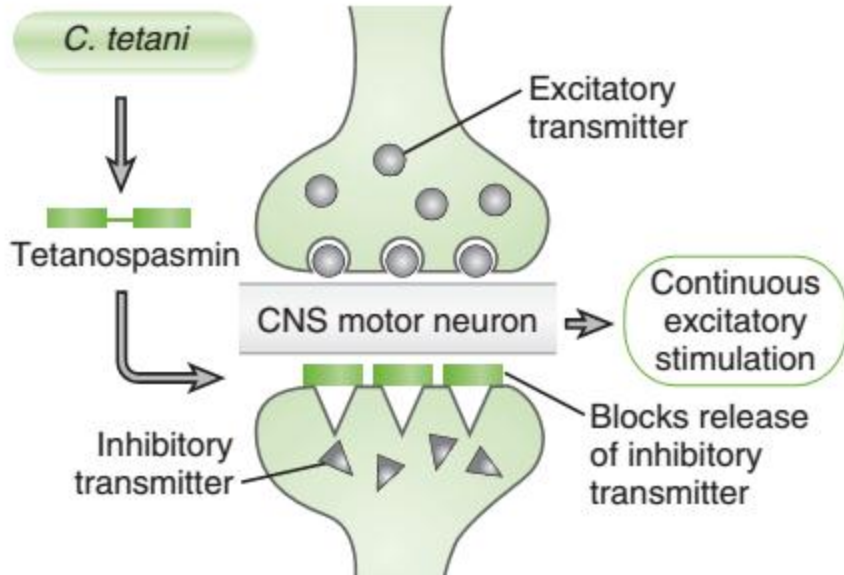


Inhibitory neurotransmitter release is thus inhibited. Lower motor neuron now become hyper excitable due to unopposed action of excitatory neurotransmitter.



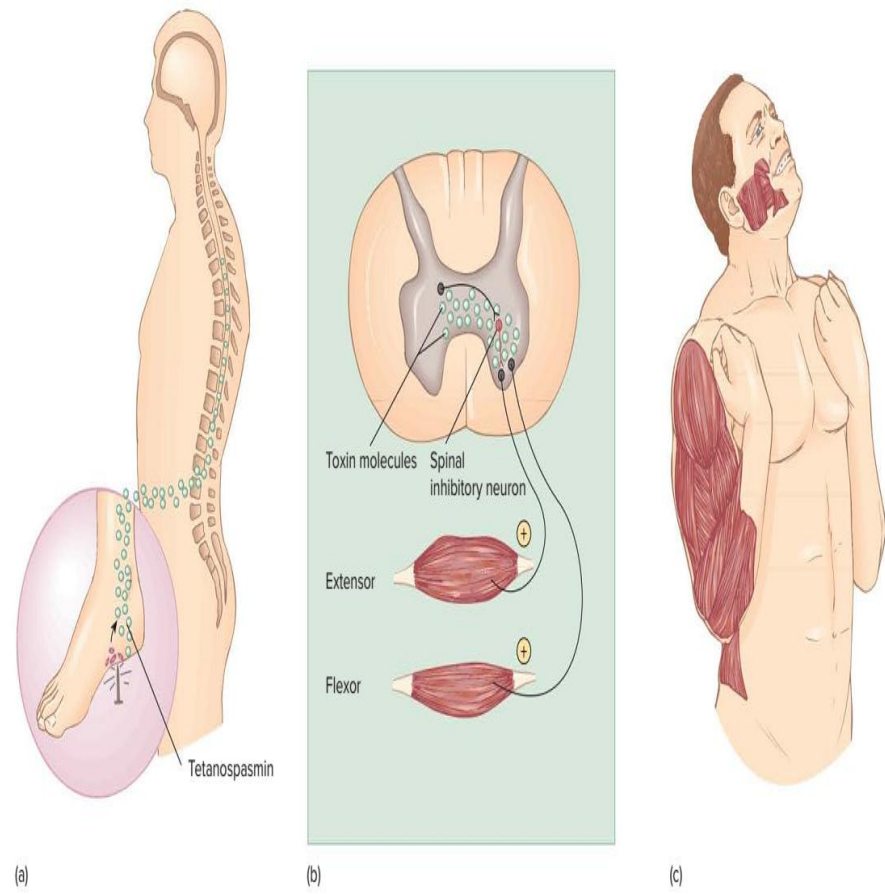
Minor stimulus causes affected muscle group to contract vigorously. **Spastic paralysis** results.

Tetanus toxin → spastic paralysis



I/P:- 4-5 days up to 3 weeks

Tetanus Pathogenesis



(a)

(b)

(c)

Tetanus

Clinical features

Trismus or
lock jaw

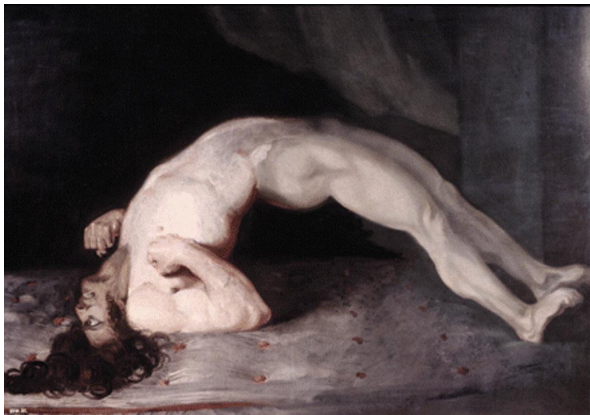
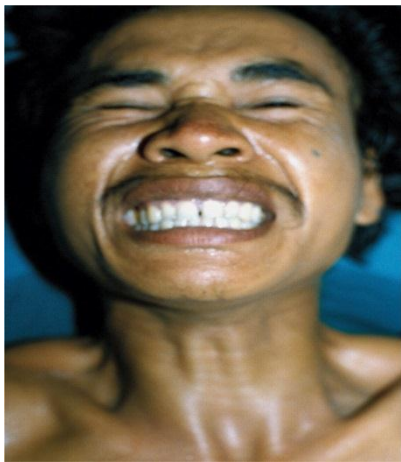
Risus
sardonicus

due to rigid contraction
of the jaw muscle

Characteristic, abnormal, sustained spasm
of the facial muscles that appears to
produce grinning(broad smile)

Opisthotonos:-

pronounced arching of
the back due to spasm
of the strong extensor
muscles of the back



Laboratory Diagnosis

- Treatment should be started immediately based on clinical diagnosis. Laboratory diagnosis helps only in confirmation.
- **Specimen:** Excised tissue bits from the necrotic depths of wounds.
- **Gram staining:** Reveal gram-positive bacilli with terminal and round spores (drumstick appearance)

Laboratory Diagnosis

- **Culture:** Culture is more reliable than microscopy:
- Robertson cooked meat broth- *C. tetani*, being proteolytic turns the meat particles black and produces foul odor.
- Blood agar with polymyxin B - under anaerobic condition. *C. tetani* produces characteristic swarming growth.
- **Toxigenicity Test:** For demonstration of toxin production
 - *In vitro* hemolysis inhibition test: detects tetanolysin
 - *In vivo* mouse inoculation test: detects tetanospasmin

Tetanus-Prevention

People of all ages need
TETANUS VACCINES



DTaP
for young children

- ✓ 2, 4, and 6 months
- ✓ 15 through 18 months
- ✓ 4 through 6 years

Tdap
for preteens

- ✓ 11 through 12 years

Td or Tdap
for adults

- ✓ Every 10 years

www.cdc.gov/tetanus



Pre exposure prevention-

- Active immunization with tetanus toxoid
- Usually given to high risk groups – Children, pregnant women, all women in childbearing age

Post exposure prevention –

- Wound debridement
- Passive immunization with tetanus immunoglobulin
- Active immunization with tetanus toxoid (depends on immunization status) - This is called simultaneous **Passive-Active immunization**
- Antibiotics to kill the vegetative bacteria

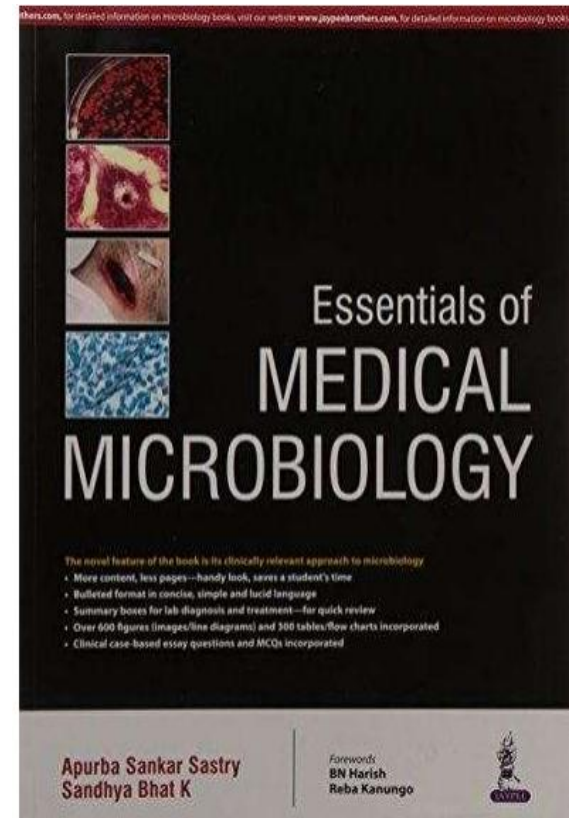
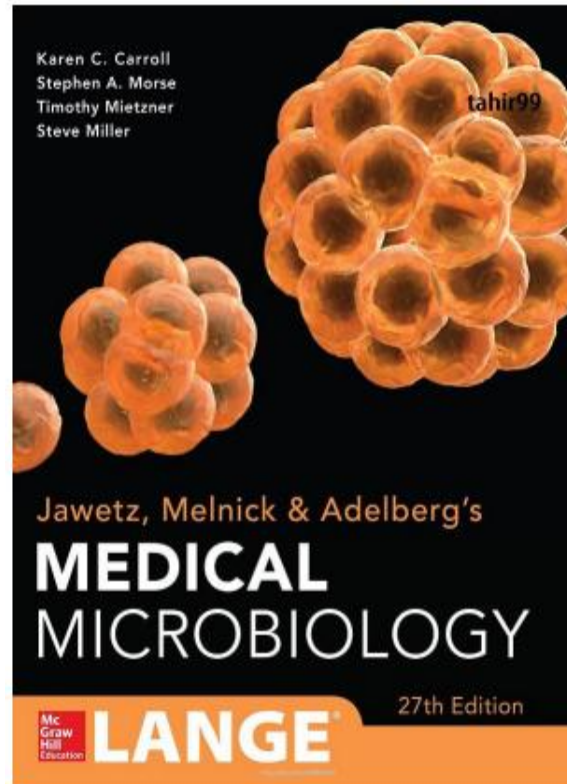
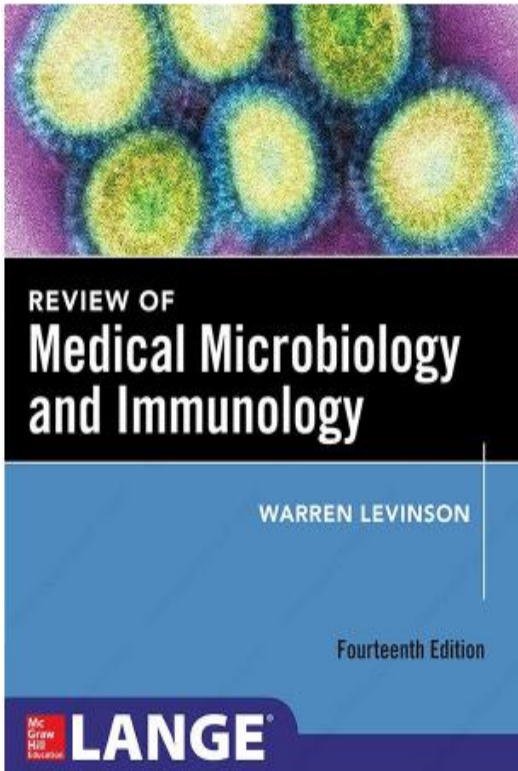
Clostridium tetani-Summery

- Gram positive, straight, slender rod with rounded ends
- Form endospore which are terminal and larger than the bacillary body(**drumstick appearance**)
- Obligate anaerobe
- Grows well in Robertson's cooked meat broth.
- Spores are highly resistant to adverse conditions
- Spores are found in soil and in the gastrointestinal tracts of a large number of animals and humans.
- Causes the disease- **Tetanus: characterized by spastic paralysis**



References

- Review of Medical Microbiology and Immunology 14th ed.-Warren Levinson.
- *Jawetz, Melnick, & Adelberg's. Medical Microbiology. 27th ed..*
- Essentials of Medical Microbiology 1sted.
Apurba shanker Shatry, Sandhya Bhat k



Thank You