

Clostridium-II

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Neurotoxic Clostridia:

2. Clostridium botulinum

General features:

- They are strict anaerobe, largely non-invasive in nature
- Produces very potent toxin responsible for food poisoning
- Soil-borne pathogen grows well in decaying organic matter
- The *C. botulinum* spores are widely distributed
- Consumption of preformed toxin
- Organisms classified into eight types *i.e.*, A, B, C α , C β , D, E, F and G types
- In blood agar, they produce narrow zone of haemolysis

Botulinum toxins:

- Eight distinct types - A to G (eg., A, B, C α , C β , D, E, F, G)
- The purified toxins are protein with difference in molecular weight.
- The toxins are very lethal – 1.0 mg of toxin is lethal for 40 million mice (*considered as the most toxic biological toxin known*)
- Synthesized as a single inactive molecule of 150 kDa
- Upon proteolytic cleavage forms two chains - one heavy (100kDa) and one light chain (50kDa) joined by a disulphide bond
- All the toxin type inhibits release of acetylcholine from nerve terminals.

Botulinum toxin and type of mammalian species affected

Botulinum toxin	Species affected
A	Human, horse, cattle, ferret, mink
B	Human, horse, cattle
C	Horse, cattle, sheep, dog, cat, mink, ferret, birds
D	Horse, cattle, sheep, dog
E	Human, mink, ferret
F	Human
G	---

- *In human cases of botulism type A, B, D and E are involved*
- *In horse cases of botulism type A, B, C and D are involved*
- *Type C (C_{α}) is involved in cases of limber neck in chicken, ducks etc.*
- *Type C (C_{β}) is involved in cases of forage poisoning in horses and cattle*
- *Type D is involved in cases of Lamziekte in cattle.*

Pathogenesis:

- Botulism is a fatal intoxication – causes neuro-paralytic condition affecting human, animals, bird and fish
- Silage, spoiled feed stuff, decaying vegetation and animal carcasses favours toxin production.
- Ingestion of preformed botulinum neurotoxins (BoNTs) leads to the condition
- Hypophosphataemia (pica) or starvation may be predisposing factor

Pathogenesis:

- The ingested Preformed neurotoxin toxin via food is absorbed from the gastrointestinal tract - circulated in the bloodstream - acts at the **neuromuscular junctions of cholinergic nerves and at peripheral autonomic synapses**
- The heavy chain of the toxin binds to receptors on the nerve endings
- The light chain enters the cytosol of the cell following endocytosis and Pore formation – it cleaves with synaptobrevins and other SNARE proteins- interfere with the release **acetylcholine** resulting flaccid paralysis.
- Death results from paralysis of **respiratory muscles**

Pathogenesis:

- Animal cases are mostly associated with type C, D, C/D and D/C
- Commonest cause:- ingestion of water/silage contaminated by small mammal or bird carcasses
- Toxin acts on the cholinergic nerve endings of peripheral somatic and autonomic fibres
- Does not have effect on brain and spinal cord

Clinical sign and symptoms:

- Clinical sign and symptoms are almost similar in different species.
 - dilated pupil,
 - dry mucous membrane,
 - decreased salivation,
 - tongue flaccidity and
 - dysphagia are features in farm animals
- The condition leads to paralysis of respiratory muscle and thus animal resort to abdominal breathing
- Affected animal remain alert and afebrile

Botulism in Birds:

- *C. botulinum* toxin affects birds of all ages.
- Large numbers of bird species are affected.
- Broiler birds, ducks and wild water fowl are quite susceptible
- The condition is characterised by paralysis of neck, wing and leg
- The affected birds exhibit diarrhoea, soiling of vent and record high mortality
- Paralysis of neck in birds is termed as “*limber neck*”

Diagnosis:

- Neurological conditions with history of consumption of contaminated feed are suggestive
- Demonstration of BoNTs using a mouse bioassay in serum
- Serum when injected into mouse gives characteristic “*wasp-waist*” appearance
- Monovalent antitoxins can be used for **toxin neutralization** to identify the toxin type involved
- PCR and nucleic acid probe methods for detecting specific toxin genes of the *C. botulinum*



Wasp Waist Appearance

Treatment and control:

- Polyvalent serum may be effective
- Activated charcoal, Vitamin AD₃E, microminerals, and probiotics supplementation
- Animals should be provided balance diet to prevent pica
- Suspected food should not be fed to the animals

Thanks