Botulism

Botulism Microbiology

- ***Clostridium botulinum***
- **Anaerobic, gram positive, rod-shaped bacteria**
- **Create spores that can remain dormant for 30 years or more**
- **Spores extremely resistant to environmental stressors, such as heat and UV light**
- **Toxin is neurotoxic protein**
- **Destroyed by heating at 100 ∘C for 20 mins.**

C. botulinum

- Botulism is a rapidly fatal motor paralysis caused by ingestion of the toxin produced by *Clostridium botulinum* types A-G.
- The spore-forming anaerobic organism proliferates in decomposing animal tissue and sometimes in plant material
- Botulism is in most cases an intoxication, not an infection, and results from ingestion of toxin in food.

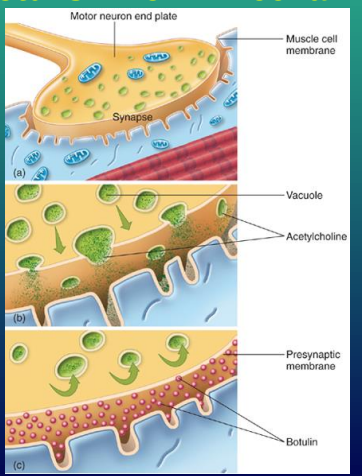
- There are seven types of *C botulinum*, differentiated on the antigenic specificity of the toxins: A, B, C_1, D, E, F, and G.
- Types A, B, and E are most important in people;
- C_1 in most animal species, notably wild ducks, pheasants, chickens, mink, cattle, and horses;
- D in cattle.
- In horses, the most common type in North America and Europe is type B and in the western USA type A has been reported in only two outbreaks, both in people, known to have been caused by type F.
- Type G, is not known to have been involved in any outbreak of botulism.

- The usual source of the toxin is decaying carcasses or vegetable materials such as decaying grass, hay, grain, or spoiled silage.
- Toxins of all types have the same pharmacologic action.
- Like tetanus toxin, botulinum toxin is a zinc-binding metalloprotease that cleaves specific proteins in synaptic vesicles.
- Motor neuron surface receptors vary for the different botulinum toxins, explaining some of the species differences in susceptibility to the different toxins.
- The exact incidence of botulism in animals is not known, but it is relatively low in cattle and horses, probably more frequent in chickens,

- Dogs, cats, and pigs are comparatively resistant to all types of botulinum toxin when challenged orally;
- however, there are recent individual case reports mentioning botulism in dogs.
- Most botulism in cattle occurs in South Africa and South America, where a combination of phosphorus deficiency in soil, and *C botulinum* type D in animals creates conditions ideal for the disease.

- **Toxicoinfectious botulism** is the name given the disease in which *C botulinum* grows in tissues of a living animal and produces toxins there.
- The toxins are liberated from the lesions and cause typical botulism.
- Gastric ulcers, foci of necrosis in the liver, abscesses in the navel and lungs, wounds of the skin and muscle, and necrotic lesions of the GI tract are predisposing sites for development of toxicoinfectious botulism.
- Type B toxin is often implicated in botulism in horses and foals in the eastern USA.
- Botulism has not been reported in cats but occurs sporadically in dogs.

Botulism Toxin Mechanism



Clinical Findings and Lesions

- progressive motor paralysis,
- disturbed vision,
- difficulty in chewing and swallowing,
- and generalized progressive paresis.
- Death is usually due to respiratory or cardiac paralysis.
- The toxin prevents release of acetylcholine at motor endplates (neuromuscular junction).
- No characteristic gross and histologic lesions develop, and pathologic changes may be ascribed to the general paralytic action of toxin, particularly in the muscles of the respiratory system, rather than to the specific effect of toxin on any particular organ.

- Epidemics have occurred in dairy herds in which up to 65% of adult cows developed clinical botulism and died 6–72 hr after the onset of recumbency.
- Major clinical findings included drooling, decreased tongue tone, dysphagia, inability to urinate, and sternal recumbency that progressed to lateral recumbency just before death.
- Skin sensation is usually normal, and withdrawal reflexes of the limbs are weak.
- Initially, clinical signs resemble second-stage parturient paresis but the cows do not respond to parenteral calcium therapy.

- Reported clinical signs in horses are very similar, with progressive muscle paresis, recumbency, dysphagia, and decreased muscle tone (tail, tongue, jaw), respiratory distress, and death.
- The most consistent necropsy findings are pulmonary edema and congestion and excessive pericardial fluid, which contains free-floating strands of fibrin.

Diagnosis

- Although sporadic cases of botulism often are suspected because of the characteristic motor paralysis, it is difficult to establish the diagnosis by demonstrating the toxin in animal tissues or sera or in the suspect feed.
- Commonly, the diagnosis is made by eliminating other causes of motor paralysis (flaccid paralysis).
- Filtrates of the stomach and intestinal contents should be tested for toxicity in mice, but a negative answer is unreliable.
- Use of ELISA methodology for detection of the toxin makes it feasible to test large numbers of samples,
- In toxicoinfectious botulism, the organism may be cultured from tissues of affected animals.

What Makes Botulism Toxin a Good Weapon?

- Mortality rate of 5-50%; long recovery period
- Weaponized by several nations including the U.S., Japan, and Soviet Union, beginning in the 1930's
- Botulism toxin - most poisonous substance known
- Highly lethal: 1 aerosolized gram could potentially kill 1 million people
- Isolated fairly easily from soil
- Could be released as an aerosol or as a contaminant in the food supply
- Expensive, long-term care needed for recovery

Categories of Botulism

- Foodborne botulism
  - caused by eating foods that contain botulism toxin
- Intestinal botulism (infant and child/adult)
  - caused by ingesting spores of the bacteria which germinate and produce toxin in the intestines
- Wound botulism
  - C. botulinum spores germinate in the wound
- Inhalation botulism
  - Aerosolized toxin is inhaled
  - does not occur naturally and may be indicative of bioterrorism

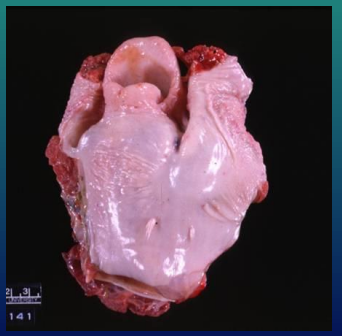
TUMORS OF GI TRACT

Papillomatosis

- Papovavirus
  - Bovine papilloma virus
  - Canine papilloma virus
- Papillomas (warts) on mucosa of mouth, esophagus, rumen (cattle)
- Usually self-limiting lesions

Papillomatosis

Papillomatosis



Epuloides (Group of tumors)

- **Fibromatous epulis**
- ossifying
- **Acanthomatous epulis (acanthomatous ameloblastoma)**

- **Fibromatous epulis**
  - **Fibrous mass arising from the periodontal ligament**
  - **Firm, hard, gray to pink**
  - **Between teeth or on hard palate near teeth**
  - **Attached to the periosteum**
  - **Do not invade bone**

- **Acanthomatous epulis** (acanthomatous ameloblastoma)
  - Odontogenic epithelial origin
  - Rough, cauliflower-like lesion
  - Locally invasive
    - Invades and destroys bone
    - Do NOT metastasize

Other tumors of dental origin

- Less common than epuloides
- Ameloblastoma
  - Dental lamina
  - Outer enamel epithelium
  - Odontogenic epithelium
  - May produce dentin or enamel matrix
  - Rare in all species

Other tumors of dental origin

- Complex odontoma
  - Fully differentiated dental components
  - Disorganized, no tooth like structures
  - Young horses
- Compound odontoma
  - Mass containing numerous tooth-like structures "denticles"
  - Young dogs, cattle, and horses
  - Mandibular or maxillary arch

Oral tumors of non-dental origin

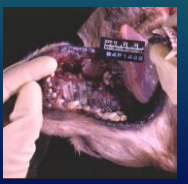
- Squamous cell carcinoma
  - Most common oral neoplasm is cats & 2ND most in dogs
    - Ventral surface of the tongue
    - Nodular, red-grey mass
      - Friable
      - Often ulcerated
    - Locally invasive
    - Metastasize to regional lymph nodes
    - Rarely metastasize to lung

Melanoma

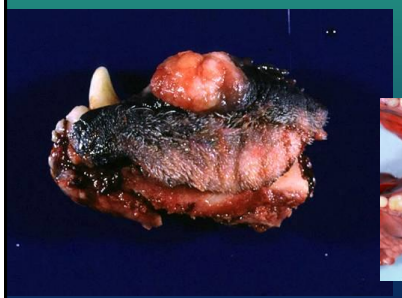
- Most common oral tumor in dogs
  - Rare in cats and large animals
- Almost always malignant
  - Most have metastasized by the time of dx
- More common in males than females
- More common in pigmented animals
- Median survival time ~ 65 days in untreated animals

Melanoma

- Gross appearance
  - Nodular, variably pigmented masses
  - Anywhere in the oral mucosa
  - Invasive and destructive
  - May or may not be ulcerated

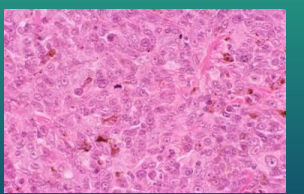


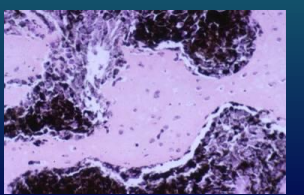
Melanoma



Melanoma

- Microscopic appearance
  - Variable
  - Heavily pigmented to amelanotic
  - Cytologically appear as round cells





Fibrosarcoma

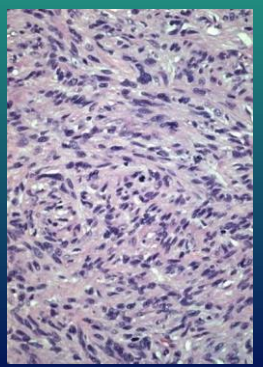
- Can occur in all animals, but usually seen in dogs
  - 3rd most common oral tumor of dogs
  - ~ 25% occur in dogs < 5 yrs of age
  - Occur in gums around upper molars and in the cranial ½ of the mandible

Fibrosarcoma

- Gross appearance
  - Nodular to multi-nodular
  - +/- ulceration
  - Firm
- Local invasion
- ~ 35% metastasize to lymph nodes
- Early pulmonary metastasis

Fibrosarcoma

- Histologic appearance
  - Moderately cellular
    - Streams of fibroblastic cells
  - High mitotic rate
  - Collagenous extra-cellular matrix



Osteosarcoma

- Bones of the skull or jaw
- Similar in appearance to fibrosarcoma
- Bone lysis and proliferation on radiographs

Round cell tumors

- Mast cell tumors
  - Discreet mass
- Lymphosarcoma
  - Tonsillar
  - Epitheliotrophic
- Plasma cell tumors
  - Discreet mass
  - Pleomorphic plasma cells

Abomasal Lymphosarcoma

- Lymphosarcoma can be primary, metastatic or multicentric in origin
- In cattle, often caused by bovine leukemia virus