

Popular Article

A Short Review on Bacillus Bacteria

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General characters

- ✓ Large, Gram-positive rods
- ✓ Endospores produced
- ✓ Aerobes or facultative anaerobes
- ✓ Growth on non-enriched media
- ✓ **Most species motile except *B. anthracis***
- ✓ Catalase-positive and oxidase-negative
- ✓ Majority are non-pathogenic environmental organisms. ***Non-pathogenic species are collectively known as Anthracoids***

Usual habitat

Bacillus species are widely distributed in the environment mainly because they produce highly resistant endospores. In soil, endospores of *B. anthracis* can survive for more than 50 years. Some *Bacillus* species can tolerate extremely adverse conditions such as desiccation and high temperatures.

Anthrax

Anthrax is a severe disease which affects virtually all mammalian species including humans. Ruminants are highly susceptible, often developing a rapidly fatal septicemic form of the disease. Pigs and horses are moderately susceptible to infection, while carnivores are comparatively resistant. ***Birds are almost totally resistant to infection, a characteristic attributed to their relatively high body temperatures.***

Epidemiology

Endospore formation is the most important factor in the persistence and spread of anthrax. The endospores of *B. anthracis* can survive for decades in soil. Soils of some regions are alkaline, rich in calcium and nitrogen and have a high moisture content. Such soil conditions also favor spore survival.

The plasmid PXO1 encodes the three components which form two exotoxins; the genes that regulate their expression are also found on the plasmid. The genes encoding capsule production and their regulations are found on the plasmid PXO2.

The capsule, composed of poly-D-glutamic acid, inhibits phagocytosis. The complex toxin consists of three antigenic components: oedema factor (Factor I), protective antigen (Factor II), and lethal factor (Factor III). Protective antigen acts as the binding moiety for both oedema factor and lethal factor.

Oedema factor is a calmodulin-dependent adenylate cyclase and, once it has entered cells following binding to protective antigen, causes increased levels of cyclic AMP. The resultant upset in water homeostasis causes the fluid accumulation seen in clinical disease. Neutrophils are the principal target of oedema factor which severely inhibits their function.

Lethal toxin consists of lethal factor, a zinc metalloprotease and protective antigen which acts as the binding domain as for oedema factor. It stimulates macrophages to release cytokines, specifically TNF and interleukin-1 beta. In naturally-occurring disease, local effects of the complex toxin include swelling and darkening of tissues due to oedema and necrosis. When septicaemia occurs, increased vascular permeability and extensive haemorrhage lead to shock and death.

Clinical signs and pathology

The incubation period of anthrax ranges from hours to days. The clinical presentation and pathological changes vary with the species affected, the challenge dose and the route of infection.

In cattle and sheep :- The disease is usually septicaemic and rapidly fatal. Although most animals are found dead without premonitory signs, *pyrexia with temperatures up to 42°C (108°F)*, depression, congested mucosae and petechiae may be observed antemortem. Animals which survive for more than one day may abort or display subcutaneous oedema and dysentery. In cattle, postmortem findings include rapid bloating, *incomplete rigor mortis*, widespread ecchymotic haemorrhages and oedema, *dark unclotted blood and blood-stained fluid in body cavities. An extremely large soft spleen is characteristic of the disease in cattle.* Splenomegaly and oedema are less prominent postmortem features in affected sheep, which are reported to be more susceptible than cattle and succumb more rapidly.

In pigs:- infection generally results in oedematous swelling of the throat and head along with regional lymphadenitis. Intestinal involvement manifests clinically as dysentery due to multifocal, haemorrhagic enteric lesions. Mortality rates may be high.

In horses:- the clinical course of anthrax is often prolonged for several days. Following

introduction of spores into abrasions, extensive subcutaneous oedema of the thorax, abdomen or legs may develop. Swelling of the pharynx, similar to that in pigs, has been described. Less commonly, colic and dysentery due to severe haemorrhagic enteritis, may result from ingestion of spores. If septicaemia occurs, extensive ecchymoses and splenomegaly are found at postmortem.

In dogs, which are rarely affected, the course of the disease and pathological changes resemble those observed in affected pig.

Treatment:

If administered early in the course of the disease, high doses of penicillin G or oxytetracycline may prove effective.

Control

Suspected cases of anthrax must be reported immediately to appropriate regulatory authorities. Control measures should be designed to take account of the prevalence of disease in a particular country or geographical region.

In Endemic regions: -

- I. Annual vaccination, particularly of cattle and sheep, is advisable. The *Sterne strain spore* vaccine should be given about 1 month before anticipated outbreaks. The spores in this live vaccine convert to non-encapsulated avirulent vegetative organisms.
- II. Chernoprophylaxis, employing long-acting penicillin, should be considered when outbreaks threaten valuable livestock.

In non-endemic regions:- following a disease outbreak:-

- I. Movement of animals, their waste products, feed and bedding from affected and adjacent premises must be prohibited.
- II. Personnel implementing control measures should wear protective clothing and footwear which must be disinfected before leaving the affected farm.
- III. Foot-baths containing sporicidal disinfectant (5% formalin, or 3% peracetic acid) should be placed at entrances to affected farms.
- IV. Contaminated buildings should be sealed and fumigated with formaldehyde before bedding is removed. Following removing of bedding and loose fittings, all drains should be blocked and the building should be sprayed with 5% formalin which should be left to act for at least 10 hours before final washing.
- V. Immediate disposal of carcasses, bedding, manure, fodder and other contaminated material is mandatory. Carcasses should be incinerated or buried deeply away from water courses.

Contaminated material and equipment must be disinfected with 10% formalin or, if appropriate, incinerated.

- VI. Scavenger animals should not be allowed access to suspect carcasses and insect activity should be minimized by application of insecticides on and around carcasses.
- VII. In-contact animals should be isolated and kept under close observation for at least 2 weeks.

Anthrax in humans

Three main forms of the disease occur in man.

1. **Cutaneous anthrax/ malignant pustule/ Carbuncle**:- is the result of endospores entering abraded skin. This localized lesion can progress to septicaemia if not treated.
2. **Pulmonary anthrax ('Wool-sorters' disease')** follows inhalation of spores. This form of the disease occur in person in wool factories. It is an acute and severe disease with haemorrhage and odema in lungs and lymph nodes.
3. **Intestinal anthrax** results from ingestion of infective material.

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