



VPH 604

ZOONOSES AND PUBLIC HEALTH

(2+1)

Course instructor:

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ANTHRAX

Synonyms

Charbon

Malignant pustule

Malignant carbuncle

MiltsiekteMilzbrand,

Ragpicker's disease,

Sang de rate,

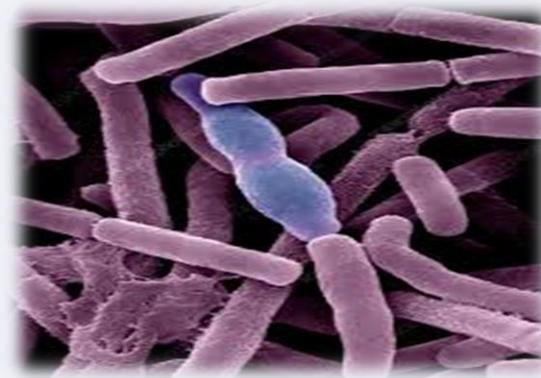
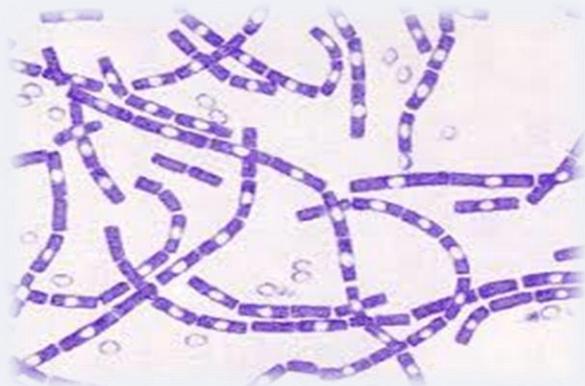
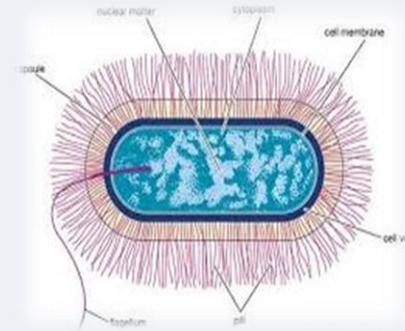
Splenic fever,

Woolsorter's disease

Anthrax is an infectious bacterial disease transmitted from animal to human (zoonosis) through consumption and industrial handling of contaminated meat and animal by-products and from animal to animal through exposure to infected forage or animal remains in the environment.

ETIOLOGY

- The causal agent: *Bacillus anthracis*
 - (Group 18, Family - Bacillaceae)
 - One of the largest (**3-5 x 1-1.2 μm**) of all bacterial pathogens
 - Aerobic,
 - Gram-positive,
 - Arranged in **long chains**
 - Non-motile sporeforming rods
 - Produce-Endospore (outside living body)



ETIOLOGY

○ Spores:

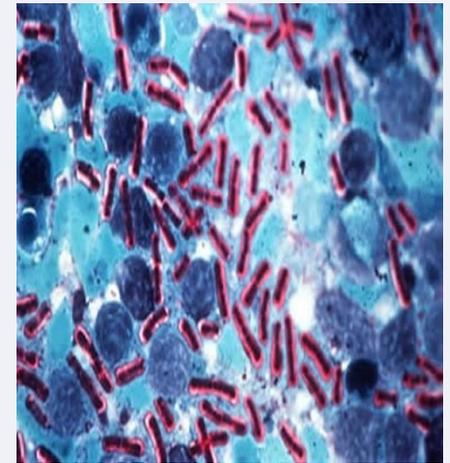
- The pathogen present in the body fluid
- Comes in contact of atmospheric air, forms highly resistant spores
- Remain viable for about 40-60 years in contaminated soil
- About 200 ± 50 years in the bones of dead hosts

○ The capsule: Body of infected host

○ Robert Koch (1876): established the **Koch's postulates**:

- Cultivated it in pure culture *in vitro*
- Inoculated into animals
- Induced anthrax

○ Louis Pasteur: First bacterial vaccine (Against anthrax)



EPIDEMIOLOGY

○ In animals

- Distributed **world wide**
- **Majority cases:** Africa, Asia & the Middle East
- **Endemic:** Russia, France & India
- **Strict legislations:** Decreased the incidence in Western Europe, Australia & North America
- **Causes heavy economic loss:** Cattle, sheep & goats till 1930s effective veterinary vaccine became available for use
- **In India:**
 - Reported from most of the states
 - Widespread: **Tamil Nadu & Maharashtra**



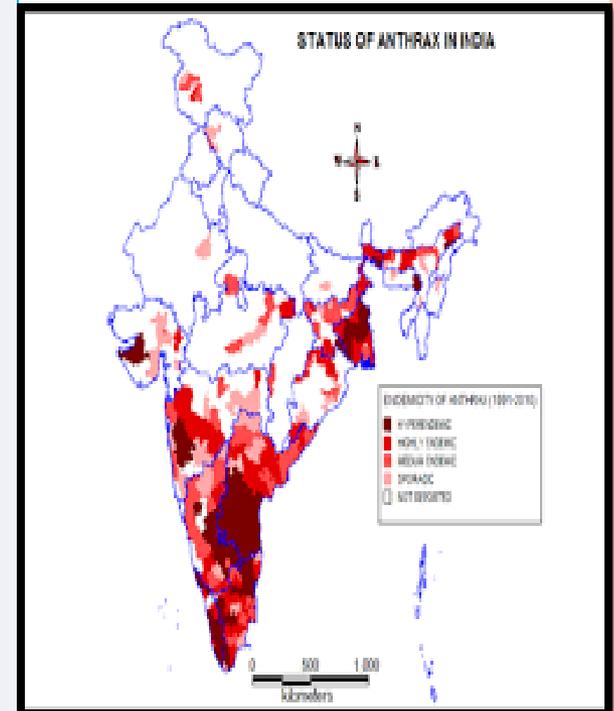
EPIDEMIOLOGY

○ In man

- The incidence : 20,000 to 1,00,000 cases/annum appx.
- Cutaneous anthrax: 95-99% of human cases globally
- Endemic: Middle-East Asia, Kenya, Gambia, Zimbabwe, Thailand, Iran, Iraq, Turkey, parts of USSR & Yugoslavia

○ In India:

- Very limited geographic locations
- The majority of cases: In trijunctional zone (South-west Andhra Pradesh, south-east Karnataka & north Tamil Nadu)



HOST RANGE AND RESERVOIRS

- **Herbivores, many wild: Highly susceptible**
- **Pigs, equines, dogs & camels: Moderately susceptible**
- **Carnivores & birds: Highly resistant**
- **Man is moderately resistant**
- It has **no** true reservoir
- **Major occupational zoonosis:**



Wool industries



Leather industries



Hair industries



Meat/ bone meal industries

SOURCES AND TRANSMISSION

❖ *In animals:*

○ **In herbivores**

- **Ingestion:** Contaminated fodder/improperly processed feed
- **Inhalation:** Spores (particularly during wallowing)

○ **In carnivores and omnivores**

- **Ingestion:** Infected carcass/contaminated meat
- **Direct contact:** Body secretions/ tissues of a diseased/dead animal contaminated fomites like soil, water, organic fertilizers, hairs, wool, hide etc.



SOURCES AND TRANSMISSION

❖ *In animals:*

○ **The indirect contact:**

- Animal husbandry/agricultural operations,
- Accidental inoculation of pathogen into skin,
- Surgical operations (bleeding, dehorning, castration)

○ **Mechanical transmission** by vectors

- Blood sucking & biting flies like blow flies
- Horse flies (Tabanidae, which transmit bacilli on mouth parts of hosts)



○ **Scavenging animals & birds** (particularly vultures): Contaminate soil & water reservoirs while defecating

○ **Direct animal to animal transmission appears to be rare**

○ **No evidence: transmission** through milk of infected animals

SOURCES AND TRANSMISSION

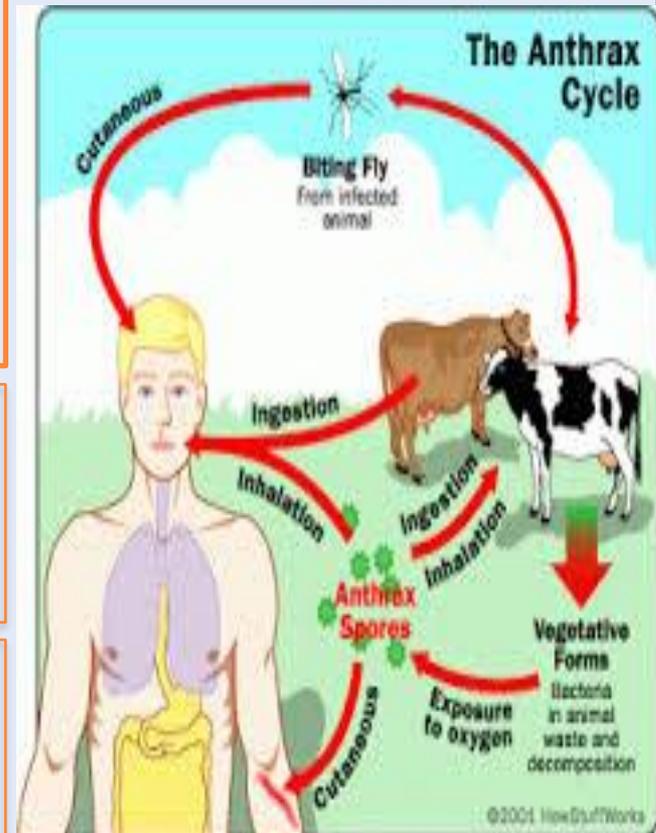
- **In man** : Directly/ indirectly from infected animals

Direct exposure to anthrax spores

1. Direct contact: Animal husbandry operations , Agricultural operations, PM examination , Rendering , Slaughtering, Dressing/removal/ handling of Hides/ wool
✓ Lead to cutaneous anthrax

2. Inhalation of spores: Dust clouds handling of dry hides, skins, bone, blood meal, meat meal etc.
✓ Lead to Pulmonary anthrax

3. Ingestion of meat from animals that have died of anthrax
✓ Lead to intestinal anthrax



SOURCES AND TRANSMISSION

4. Laboratory acquired infection

5. **Person to person transmission:** extremely rare, but wound dressing & communal loofa sharing

In-Direct exposure to anthrax spores

6. **Mechanical transmission by vectors:**
Stable fly, horse fly, mosquitoes

7. **Use of infected needle for transmission**



DISEASE IN ANIMALS

❖ The general symptoms of anthrax:

Severe mucosal congestion leading to haemorrhages from mouth, anus & nares (**pathognomic**)

- Elevated body temperature (**40-41.6⁰C** in cattle)
- Dyspnoea,
- Generalized oedema ,
- Excitement or depression,
- Anorexia, convulsions,
- Staggering gait,
- Diarrhoea/dysentery,
- Abortion,
- Blood stained milk
- Absence of rigor mortis



DISEASE IN ANIMALS

○ In Herbivores:

○ Hyperacute (sudden death 10-24 h)

- Due to septicaemia & toxicaemia
- High fatality rate
- Apoplectic/fulminant/ per acute form



○ Cutaneous anthrax

- Bite of mechanical vectors
- Wound contamination,
- Death usually:
Before eschars/ carbuncles develop



○ Gastro-intestinal form: Most common



DISEASE IN ANIMALS

❖ In Carnivores

- The disease may be fatal or recovery takes place
- **Intestinal form:** Occasional
 - Ingested pathogen: localized in pharyngeal lymph node
Causing oedematous swelling (in dog, also in swine)
 - Death: Occlusion of air way
- Carbuncular lesions may develop on tongue or oropharynx



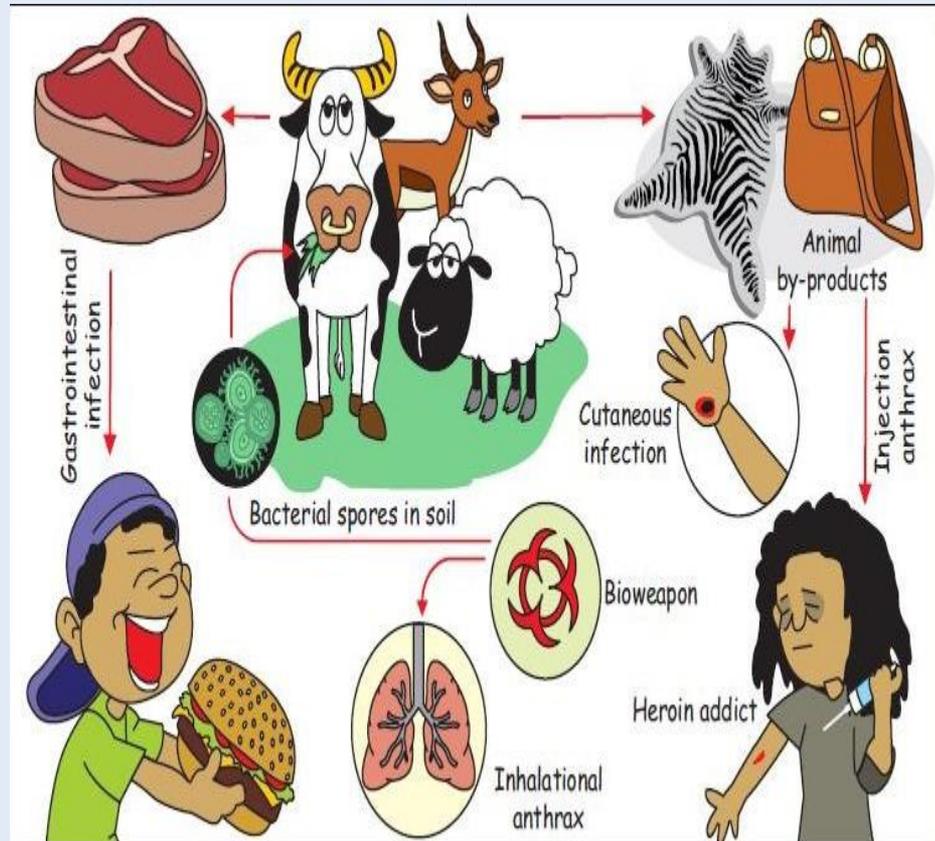
DISEASE IN MAN

- Disease in man
- The incubation period is variable (usually 2-5 days)
- Human anthrax occurs in the following three forms

1. Cutaneous form

2. Pulmonary form

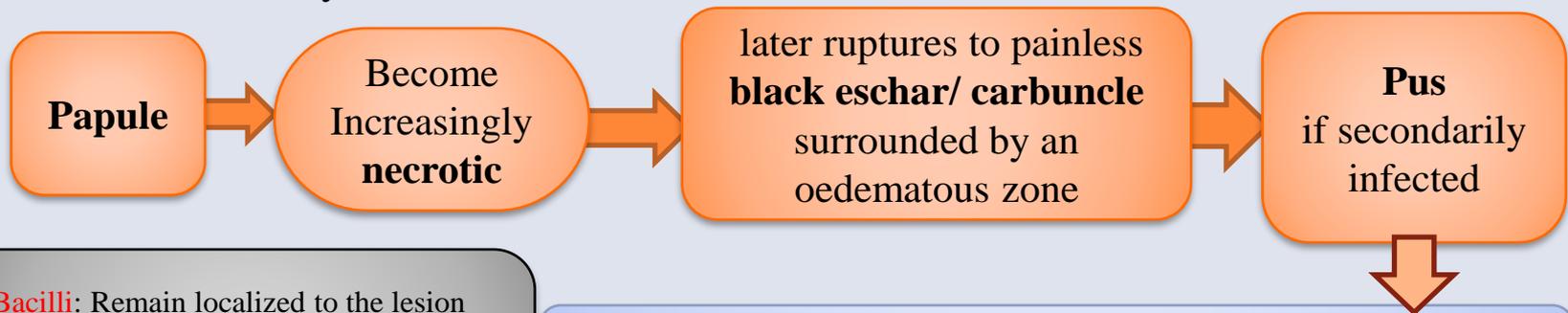
3. Gastrointestinal form



DISEASE IN MAN

1. Cutaneous form (malignant pustule/eschar) : 90% of cases

- ✓ Spores entering the skin through cuts & abrasions
- ✓ Often self limiting
- ✓ Characterized by the:



Bacilli: Remain localized to the lesion
Causes: Meningitis/cellulitis
Adenitis: regional lymph node
Gangrene: occasional complication
Untreated cases: outcome is fatal

Fever (40°C), chills, headache, nausea & anorexia quickly leads to dyspnoea, cyanosis, lymphangitis & collapse preceding death



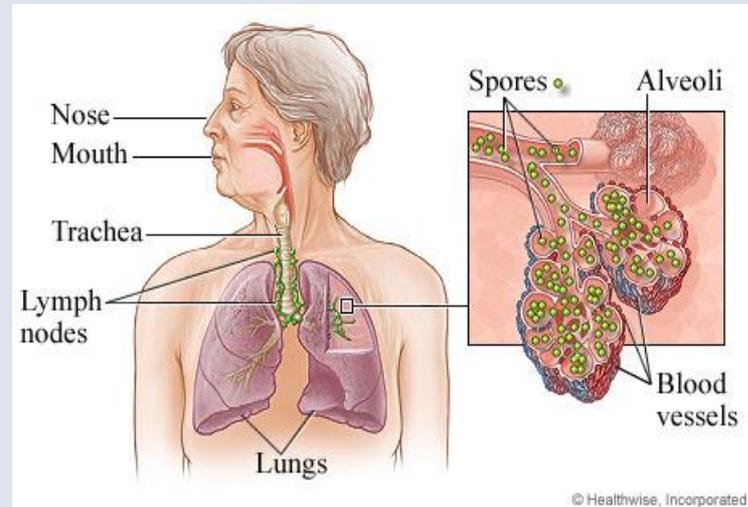
DISEASE IN MAN

2. Pulmonary form (**wool sorter's disease**):

- By inhalation of airborne spores

(Handling raw wool, hides, bones, blood meal/ meat meal)

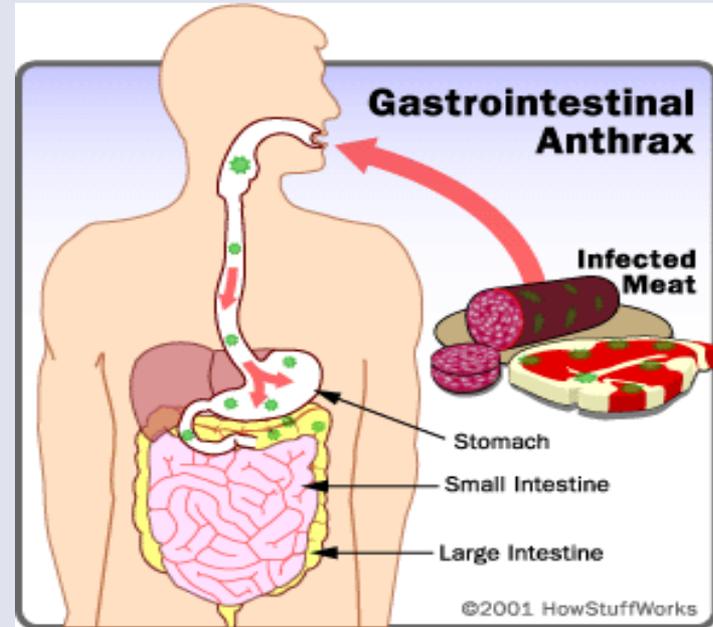
- The form is characterized by
 - Fever,
 - Dyspnoea,
 - Pneumonia,
 - Emphysema & cardiac failure
 - Septicaemia:
 - ✓ Highly fatal
 - ✓ Causing death in few hours



DISEASE IN MAN

3. Intestinal form :

- By ingestion of spores
(Infected meat, milk or other foodstuffs)
- Characterized by:
 - Eschar or malignant carbuncle
(On the oropharynx, stomach, duodenum & upper ileum)
- The most common symptoms
 - Nausea, vomiting,
 - Anorexia, fever,
 - Abdominal pain,
 - watery to bloody diarrhea
 - Tenderness in right upper & lower quadrant



DIAGNOSIS

In animals :

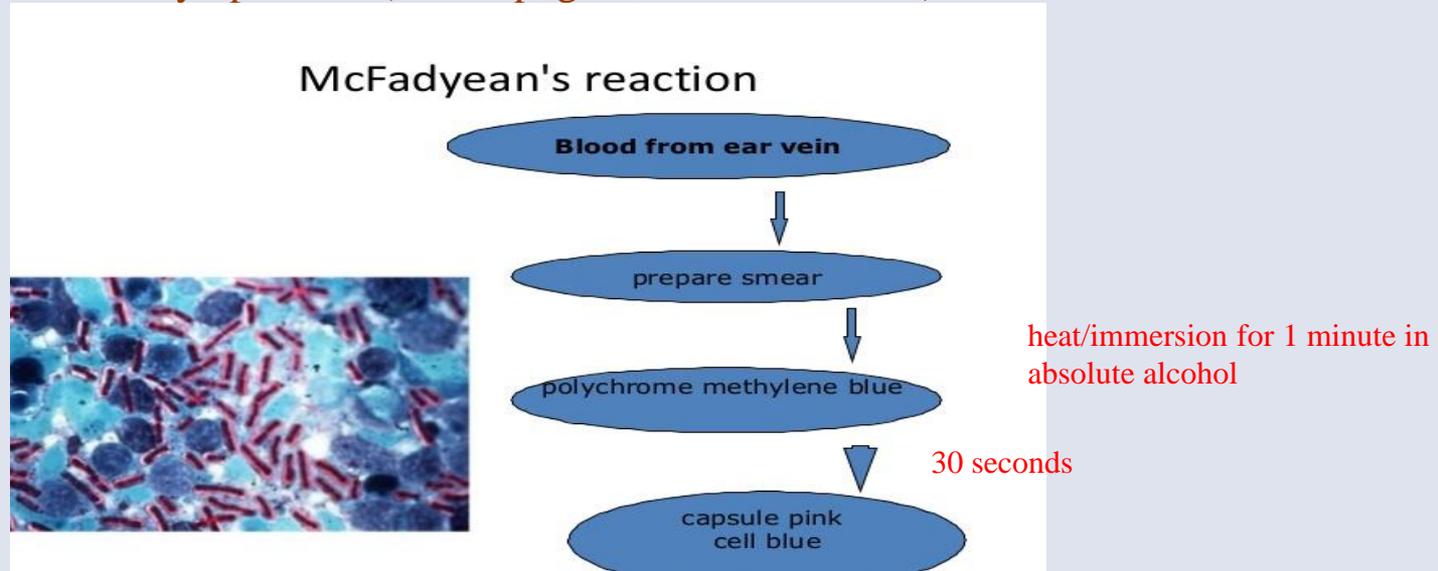
1. Based on history & clinical sign:

(Sudden death, Bleeding from natural orifices, the carcass is never opened to avoid)

2. Microscopic examination of organism:

Samples: Blood smears prepared from ear clippings (in all animals including wild), laryngeal oedema (in dog and pig)

Mesentric lymph node (in sheep, goat, cattle and horse) are stained



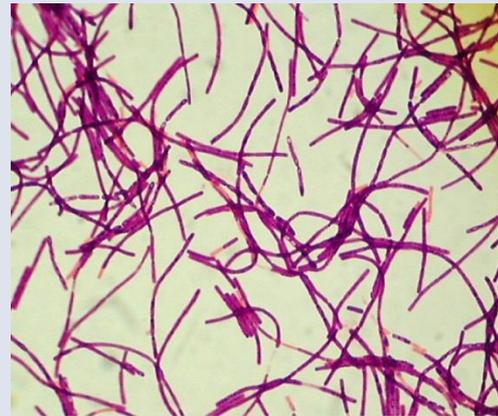
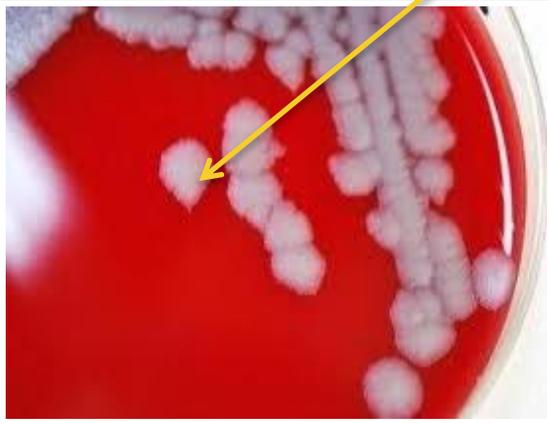
bacterial capsule appears reddish purple whereas bacilli takes deep blue colour)

DIAGNOSIS

3. Isolation of the pathogen:

On blood agar:

- Characteristic morphology of bacilli
- Colony morphology: **‘medusa head’**



4. Inoculation of laboratory animals

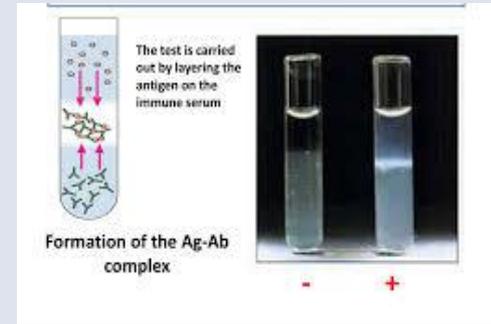
- Guinea pigs, s/c/ mice, i/p clinical material (0.5 ml)
- Death occurs within 30-40 h p i



DIAGNOSIS

5. Ascoli's precipitation test:

- Using anthrax hyperimmune serum
- Against attenuated anthrax spores
- Detection of anthrax antigens in tissues/hides

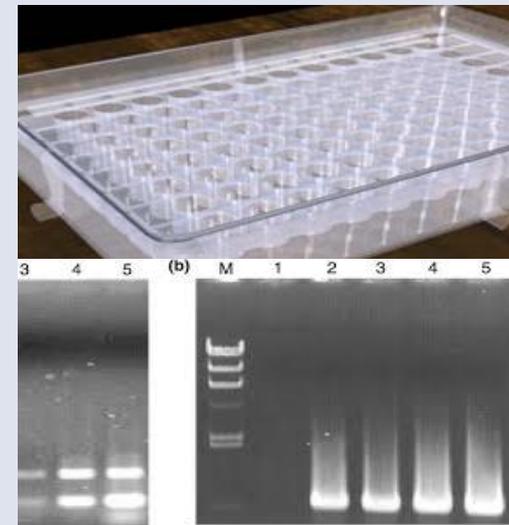


6. Serological test:

- Specific & sensitive
- Enzyme immunoassays
- For detection of antigens in body fluids

7. Molecular test:

- Polymerase chain reaction(PCR)
- Specific & sensitive



- ❖ (If, mistakenly, the carcass has been opened, the dark unclotted blood & strikingly large haemorrhagic spleen is seen)

DIAGNOSIS

In man:

Presumptive diagnosis:

- On the basis of characteristic symptoms
- Characteristic lesions (eschar)
- History of case (particularly in high-risk population from endemic areas)

Confirmatory diagnosis:

- by different diagnostic aids described earlier

Treatment

- **Drug of choice:**

Penicillin (V or G): for 5-7 days
by oral, i/m or i/v route

- **Streptomycin:** synergistically with penicillin

- **Other drugs**

- Tetracycline,
- Gentamicin,
- Erythromycin
- Chloramphenicol.



Prevention and control

In animals:

1. Immunization :

- Vaccination of animals in endemic areas
- Single dose of **Sterne vaccine** (attenuated live spore vaccine , s/c)
- A vaccine containing live spores and a toxoid prepared from a special strain of *B. anthracis* is also used



2. Proper carcass disposal :

- An anthrax carcass **should not** be opened
- **The carcass should be destroyed:** by burning/ by deep burial (Atleast 6 feet under thick cover of anhydrous calcium oxide i.e. quick - lime following its chemical disinfection by formaline etc.).
- The ground/area where carcass was lying **should be disinfected**
(3% peracetic acid (8 litres/meter²) or 3-5% formaldehyde (40 litres/carcass))

Prevention and control

3. Care in handling livestock (diseased/from endemic areas) :

- ✓ **Early diagnosis** & prompt chemotherapy of sick animals
- ✓ **Slaughter of an suspected animal**: Should not be allowed
- ✓ **Animals from endemic area: Quarantined**
 - Before slaughter/ admixing with new animals
- ✓ **Wound dressing** : with sterilized equipments & clean hands
- ✓ **Persons with cutaneous lesions**: not allow to handle livestock and their feed/fodder

4. Management :

- ✓ **Notify disease** to surveillance, monitoring & controlling agencies
- ✓ **Avoid feeding contaminated feeds**
- ✓ **Avoid having livestock grazing on contaminated areas** i.e. streams, low lying pasture lands
- ✓ **Insect control measures** to bring down vector population in endemic areas

Prevention and control

In man:

1. Immunization :

- It is impracticable to vaccinate human beings in endemic areas
- Occupational contact with livestock/ livestock products may be vaccinated

(Sterne, Wright alum treated, cell free or formaline treated vaccines, or purified toxoid)

2. Animal industry hygiene and management

- Control the disease in **animal population**
- Careful handling of **animal product/byproduct**
- Disinfection of factory premises: **vapourized formaldehyde** may be used for along with measures to control dust

3. Medical care and management



HUMAN VACCINE

The Current U.S. vaccine (FDA Licensed)

Manufactured & distributed by BioPort, Cor., Lansing, Michigan

- Culture supernatant (PA) of attenuated non-encapsulated strain
- Serologic response
 - 83% after 3 doses
 - 100% after 5 doses
- Protective efficacy
 - In cutaneous anthrax Proven (human data)
 - In inhalational anthrax Possibly (animal data)
 - 3 dose (0, 2 & 4 weeks) May be effective
- Availability - Limited

HUMAN VACCINE

The immunization Schedule :

- ➔ 3 S/C injections : 2 weeks apart
- ➔ 3 additional S/C injections : at 6, 12 & 18 months.
- ➔ Booster injections : Annually

Adverse reactions?

- Mild local reactions in 30% : Slight tenderness, swelling, redness at the injection site up to 72 h
- Severe local reactions Infrequent : Local reaction as above + Extensive swelling of forearm for 1-2 days
- Systemic reactions in <0.2% : Generalized symptoms