

Module: Infection & Inflammation

Topic: Rabies, Tetanus & Anthrax

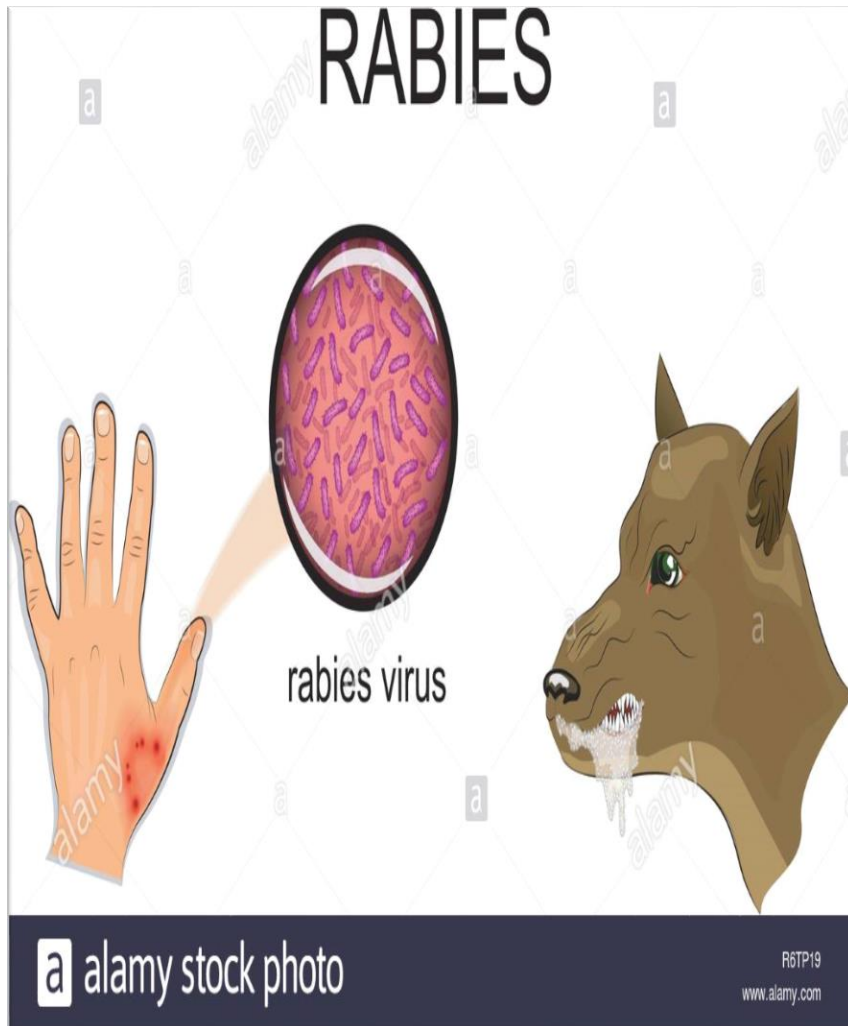
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Learning outcomes:

- Explain the pre and post prophylaxis of rabies
- Describe epidemiology, types, and prevention measures of anthrax
- Describe the etiology, risk factors, clinical features and prophylaxis of pre and post exposure of tetanus



Rabies: A zoonotic disease (transmitted from animals to humans)

It is almost always fatal after onset of clinical symptoms.

Agent: Rabies virus - genus *Lyssa*.

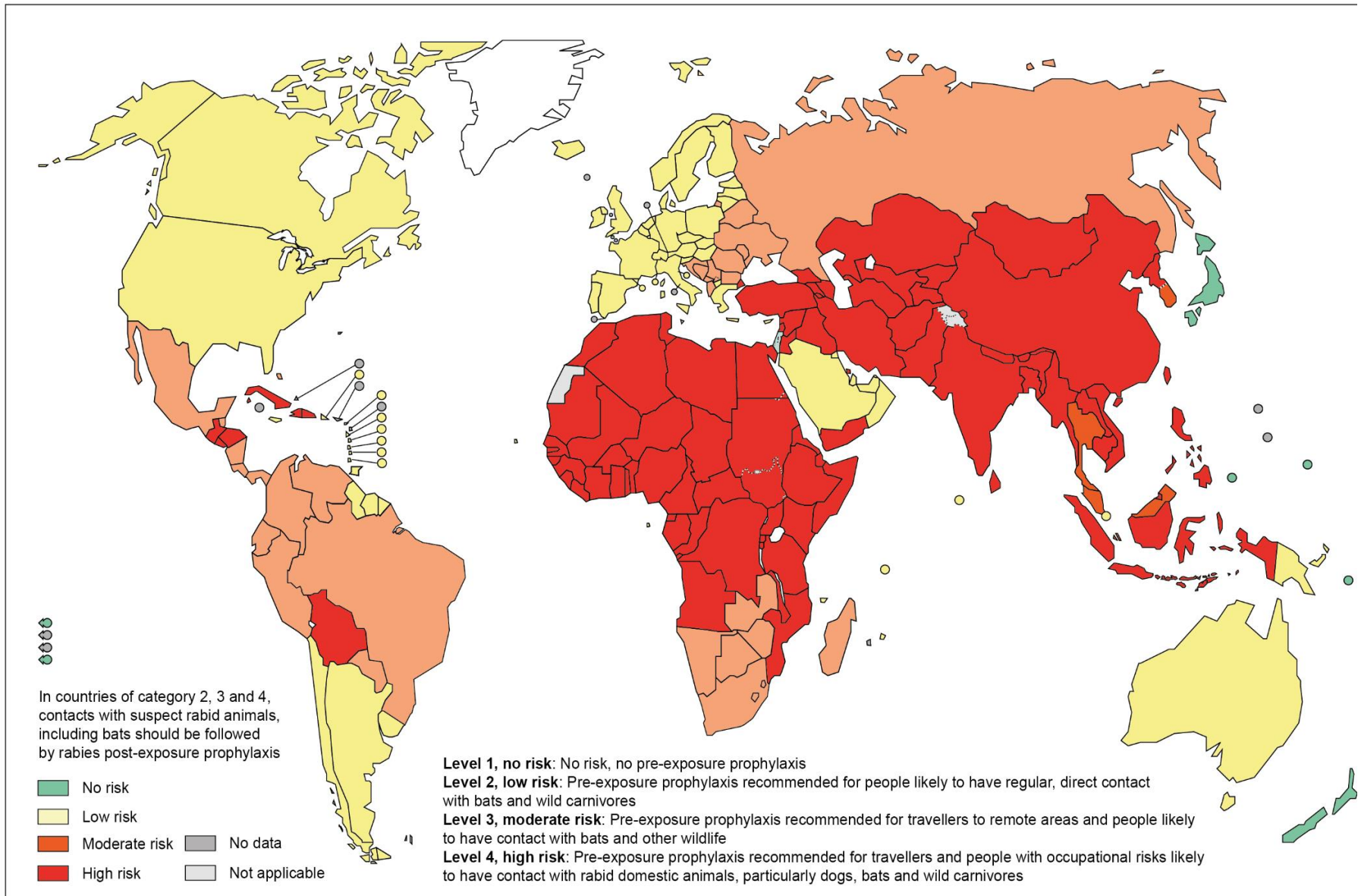
Reservoir and host of rabies

- Domestic mammals like cats, cattle, and dogs are the most frequent reservoir of rabies.
- The most common wild reservoirs of rabies are raccoons, skunks, bats, and foxes.

Epidemiology

- It affect both domestic and wild animals and up to 99% of cases, dogs are responsible.
- Rabies is present on all continents, except Antarctica.
- Every year, more than 15 million people worldwide receive a post-bite vaccination.
- Approximately 59, 000 people die from rabies each year.
- Most of these deaths occur in Asia and Africa.
- Children are at particular risk.

Distribution of risk levels for humans contacting rabies, worldwide, 2018



Transmission

- Virus enters peripheral nervous system of humans via wound
- Then travels toward CNS causing inflammation of spinal cord and brain.
- Once the symptoms develop, treatment is almost never effective, and mortality is over 99%.

5 Virus reaches brain and causes fatal encephalitis.

4 Virus ascends spinal cord.

3 Virus moves up peripheral nervous system to CNS.

2 Virus replicates in muscle near bite.



6 Virus enters salivary glands and other organs of victim.

1 Virus enters tissue from saliva of biting animal.

Incubation Period:

- The incubation period for rabies is typically 2–3 months but may vary from 1 week to 1 year.
- **Symptoms depend on the,**
 1. Location of bite
 2. Severity of wound
 3. Amount of virus introduced

Rabies symptoms in humans

Initial symptoms

The first symptoms of rabies may be very similar to those of the flu, including general weakness or discomfort, fever, or headache. These symptoms may last for days.



Headache



Fever



Fatigue



Tingling at site of exposure

Rabies-specific symptoms

As the disease progresses, the person may experience delirium, abnormal behavior, hallucinations, hydrophobia (fear of water), and insomnia.



Hallucinations



Excessive salivation



Light sensitivity



Hydrophobia



Insomnia



Aggression

Diagnosis:

- Clinical diagnosis of rabies is informed by patient presentation and history of exposure to a suspected rabid animal
- The direct fluorescent antibody test is the gold standard for rabies diagnosis.

Rabies vaccine by Louis Pasteur

- Louis Pasteur developed live attenuated rabies vaccine by growing the virus in rabbits, then drying the affected nerve tissue to weaken the virus.
- In 1885, Pasteur administered the vaccine to Joseph Meister (a 9-year-old boy) who had been attacked by a rabid dog. The boy survived.

Louis Pasteur and Joseph Meister, the 1st person to receive Pasteur's rabies vaccination.



Management and Prevention:

I. Pre – exposure prophylaxis

II. Post - exposure prophylaxis consists of:

1. Local treatment of the wound

2. Rabies vaccination

i. Rabies immunoglobulin

ii. Anti rabies vaccine

I. Pre – exposure prophylaxis

- It is recommended for anyone who is at continual, frequent or increased risk for exposure to the rabies virus, as a result of their occupation or residence such as:
 1. Laboratory staff, veterinarians, animal handlers and wildlife workers)
 2. Children living in or visiting rabies affected areas.
 3. Travellers travelling to rabies-affected areas.

Cont.

- ***Intramuscular:*** three doses of 1ml anti rabies vaccine ***HDCV or PCEC*** should be administered intramuscularly (deltoid area) on;
 - Days 0
 - 7 and
 - 21 or 28.

II. Post exposure prophylaxis:

i. Local Treatment of wound:

- Wash wound immediately and thoroughly for at least 15 minutes with soap and water (*to denature & destruct virus*).
- Apply antiseptic lotion
- Leave the wound open (*rabies wound is not stitched as this could expose nerve endings to rabies virus, if suturing is necessary, ensure that immunoglobulin has been applied locally*)
- Give tetanus toxoid (TT) vaccination booster
- Give antibiotics for secondary infection



2. Rabies vaccination

A. Rabies Immunoglobulin(Passive immunization)

a. Human Rabies Immunoglobulin (HRIG)

b. Equine Rabies Immunoglobulin (ERIG)

- ***Rabies immunoglobulin are used after bite.***
- Administered just before or shortly after 1st dose of anti - rabies vaccine till 7th day.
- Full dose or as much as feasible should be administered into and around the wound site, remainder is given

- Intramuscular at a distant site from active vaccine administration.
- **Dosage:**
 - a. HRIG is 20 IU/Kg body wt.**
 - b. ERIG is 40 IU/kg body wt.**
- Suppose a person weighs 72 kg, was bitten by a dog.
- The immunoglobulin dose calculated for him will be:
 - **HRIG is 20 IU/Kg body wt. = $72 \times 20 = 1440$ IU**
 - **ERIG is 40 IU/kg body wt. = $72 \times 40 = 2880$ IU**



Rabies Immunoglobulin



B. Anti - Rabies Vaccination:

2 types of rabies vaccine PEP

- i. Human diploid cell vaccine (HDCV) and*
- ii. Purified chick embryo cell culture vaccine (PCECV)*

Cont.

- Should always be used for post-exposure prophylaxis.
- Vaccines should be injected into the deltoid muscle for adults and children aged 2 years and more.
- The anterolateral thigh is recommended for younger children.
- Vaccines should not be injected into the gluteal region.

- ***The 5 dose intramuscular regime: (1-1-1-1-1)***

- One dose of the vaccine should be administered on days 0, 3, 7, 14 and 28

- Given in the deltoid region or, for young children, into the antero-lateral area of the thigh muscle

- ***The 2-1-1 regimen: (2-0-1-0-1)***

- Two doses are given on day 0 in the deltoid muscle, right and left arm

- An additional one dose is administered in the deltoid muscle on day 7 and day 21

Treatment after development of rabies

- 100% mortality after development of symptoms.
- Only palliative therapy is given at this stage:
 - i. Pain relief (morphine)
 - ii. Reduction of spasms (muscle relaxants, diazepam).
 - iii. Isolation
 - iv. Staff should be preferably vaccinated, but not obligatory

Prognosis

- In unvaccinated humans, rabies is almost always fatal after neurological symptoms have developed
- Vaccination after exposure, PEP, is highly successful in preventing the disease if administered promptly, (*in general within 6 days of infection*)
- PEP is 100% effective against rabies

- ***Street rabies virus*** is obtained from a naturally infected animal and usually virulent, as opposed to a laboratory-attenuated strain.
- ***Fixed rabies virus*** made constant in its reactions by repeated passage through a host other than the usual host.



Tetanus

By Dr. Warda Salahuddin



- Tetanus is a non-communicable disease.
- ***Derived from Greek word tetanos*** - stretch.
- The bacteria invade the body, to produce a poison (toxin) that causes painful muscle contractions.
- Another name for tetanus is “lockjaw” as it causes a person’s neck and jaw muscles to lock, making it hard to open the mouth or swallow.

Causes

1. Contaminated wounds
2. Lacerations
3. Injection sites
4. Abrasions
5. Burns
6. Frostbites
7. Foreign bodies
8. Surgeries incisions
9. Unhygienic child births.

Epidemiology



- ***Host:*** Humans, domestic & wild animals
- ***Causative Agent:*** Clostridium tetani spore-forming bacteria.
- The spores are widely distributed in the soil, in the intestines and feces of horses, sheep, cattle, dogs, cats, rats, guinea pigs, & chickens.
- Manure-treated soil may contain large numbers of spores.

- ***Communicability:*** Not directly transmitted from person-person.
- ***Age:*** Affect any age.
- ***Distribution:*** Tetanus occurs worldwide and is endemic in many developing countries.
- Incidence in developed countries is low due to effective vaccination programs.

Pathogenesis:

- Anaerobic conditions allow germination of spores and production of toxins
- Toxin binds in central nervous system
- Interferes with neurotransmitter release to block inhibitor impulses
- Leads to unopposed muscle contraction and spasm

Signs & Symptoms of Tetanus



FEVER



**HIGH BLOOD
PRESSURE**



MUSCLE SPASMS



LOCKJAW



SWEATING



**DIFFICULTY
SWALLOWING**

- ***Incubation period:*** 8 days (range, 3-21 days)
- ***Three clinical forms:***
 1. Local (uncommon)
 2. Cephalic (rare)
 3. Generalized (most common): descending pattern of trismus (lockjaw), stiffness of the neck, difficulty swallowing, rigidity of abdominal muscles
- Spasms continue for 3-4 weeks
- Complete recovery may take months

3. Generalized tetanus:

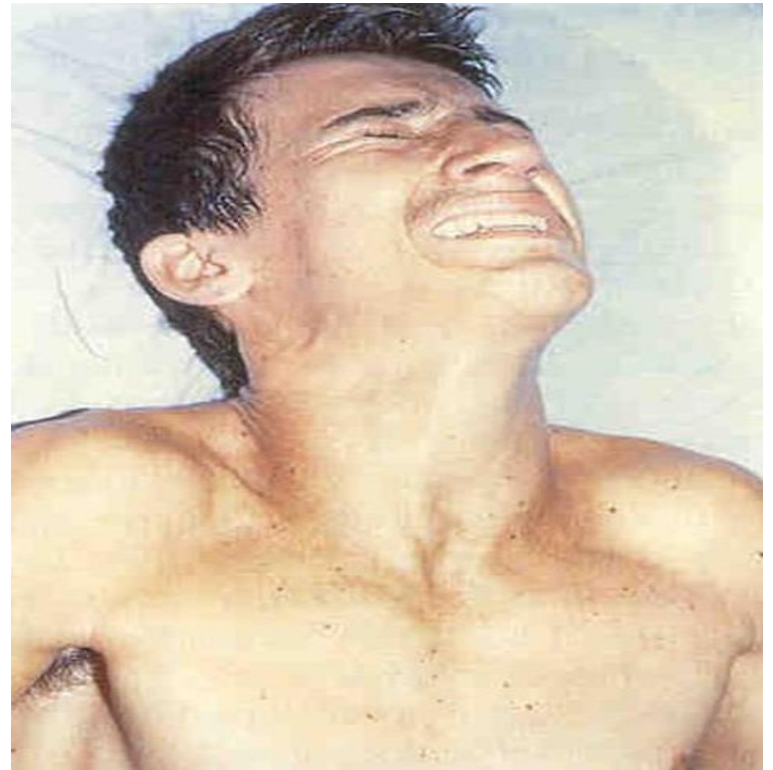
- Most common form, more than 80% of cases.
- Initial sign is spasm of the muscles of the jaw or “lockjaw” followed by painful spasms in other muscle groups in the neck, trunk, and extremities and by generalized, seizure-like activity or convulsions in severe cases.

Risus sardonicus:

A sardonic smile (facial
muscle spasms)



Lock Jaw





Opisthotonos: Progressive and intense muscle spasm leads to characteristic arching of back and fractures.

- 1. *Wound care***
- 2. *Medications***
- 3. *Supportive care***

- 1. *Wound care***

Clean wound thoroughly by soap & water to remove dirt, foreign bodies and dead tissue from wound to prevent growth of tetanus spores.

Management:



Medications

- ***Antibiotics.*** To fight tetanus bacteria.
- ***Sedatives.*** Sedatives to control muscle spasms.
- ***Other drugs.*** Like magnesium sulfate, beta blockers & morphine to regulate involuntary muscle activity, regularize heartbeat and breathing
- IV fluids
- ***Supportive therapies:*** Long period of treatment in an intensive care settings. E.g. ventilator

Prevention

- Tetanus can be prevented through immunization
- Neonatal tetanus can be prevented by immunizing women of childbearing age with TT, either during pregnancy or outside of pregnancy.
- This protects the mother and – and through a transfer of tetanus antibodies to the foetus – also her baby.

Vaccinations

2. Anti Tetanus vaccine

3. Tetanus toxoid (TT)



Anti Tetanus vaccine

- Neutralizes the toxin produced by *Clostridium tetani*.
- Used to provide temporary passive immunity.
- Contraindicated: not used when anti tetanus immunoglobulin is available, or the patient is allergic (give test dose)
- The dose is usually from 1500 - 6000 units.

Tetanus Toxoid

- Best tool to prevent tetanus
- Recommended for people of all ages, with booster shots throughout life.
- After three doses almost everyone is immune.
- Pregnant women can be immunized against tetanus this can prevent neonatal tetanus.

Routine TT schedule in EPI

- ***A Pentavalent vaccine is 5 vaccines conjugated in one***
 1. PENTAVLENT - 1 at 6 weeks
 2. PENTAVLENT - 2 at 10 weeks
 3. PENTAVLENT - 3 at 14 weeks
- 3 booster doses should be given 1st during 2nd year of age
- 2nd during 4–7 years of age
- 3rd during 9–15 years of age.



Tetanus neonatorum



- Neonatal tetanus is a **generalized tetanus infection of the newborn**. It usually gets transmitted from an unvaccinated mother and enters the body through infection of unhealed umbilical stump. This typically happens when the umbilical cord is cut using unsterile instruments.

Prevention of neonatal tetanus

Dose of Td (according to card or history)	When to give	Expected duration of protection
Td1	At first contact or as early as possible in pregnancy	None
Td2	At least 4 weeks after Td1	1 - 3 years
Td3	At least 6 months after Td2 or during subsequent pregnancy	At least 5 years
Td4	At least one year after Td3 or during subsequent pregnancy	At least 10 years
Td5	At least one year after Td4 or during subsequent pregnancy	For all childbearing years and possibly longer

ANTHRAX





Collin Powell giving a presentation to the United Nations Security Council

Anthrax spores were used as biological weapon for bioterrorism.

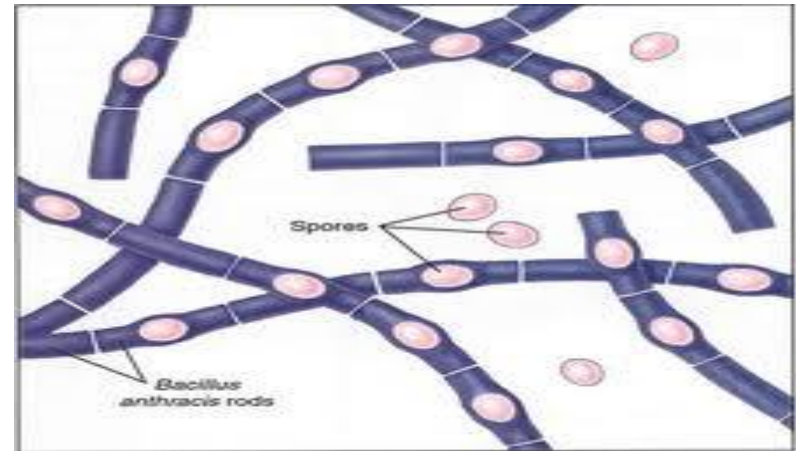
In 2001, anthrax spores were sent through the U.S. Postal Service.

It infected 22 people and 7 survivors had confirmed cutaneous anthrax disease.

Definition:

A serious disease, affects both humans and animals. Most forms of disease are lethal.





- ***Causative Agent:***
- Bacillus anthracis, a gram-positive, aerobic non motile, rod-shaped, spore-forming bacterium.
- ***Reservoir:*** Spores produced by bacteria these can survive for decades.

High Risk People:

- Veterinarians
- Laboratory professionals
- Livestock producers
- People who handle animal products i.e. make or play animal hide drums:
- During a bioterrorism event.
- Travelers travelling to high risk areas.



Mode of Transmission:

- *Anthrax does not spread directly from infected animal or person to another. The disease spread by spores.*
- ***Types of anthrax infection:***
 1. Cutaneous anthrax.
 2. Inhalation Anthrax.
 3. Gastrointestinal anthrax.

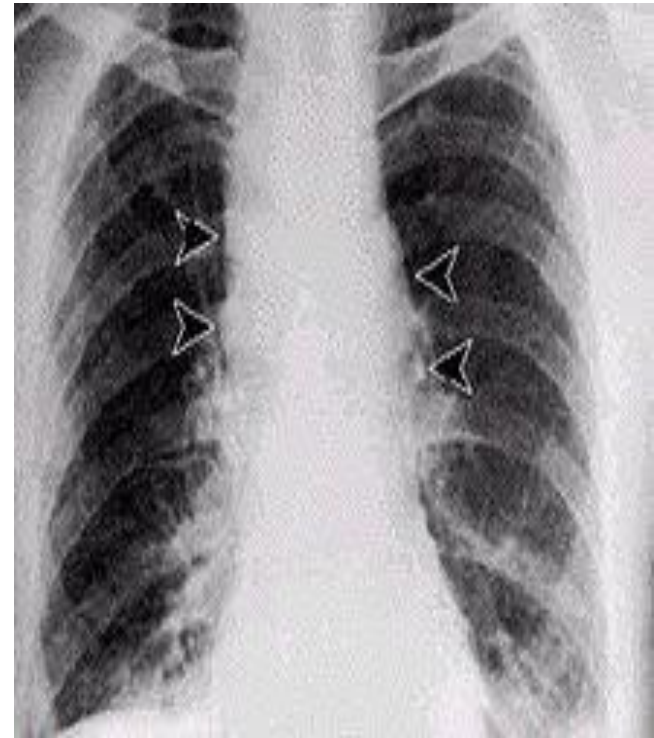
Cutaneous Anthrax



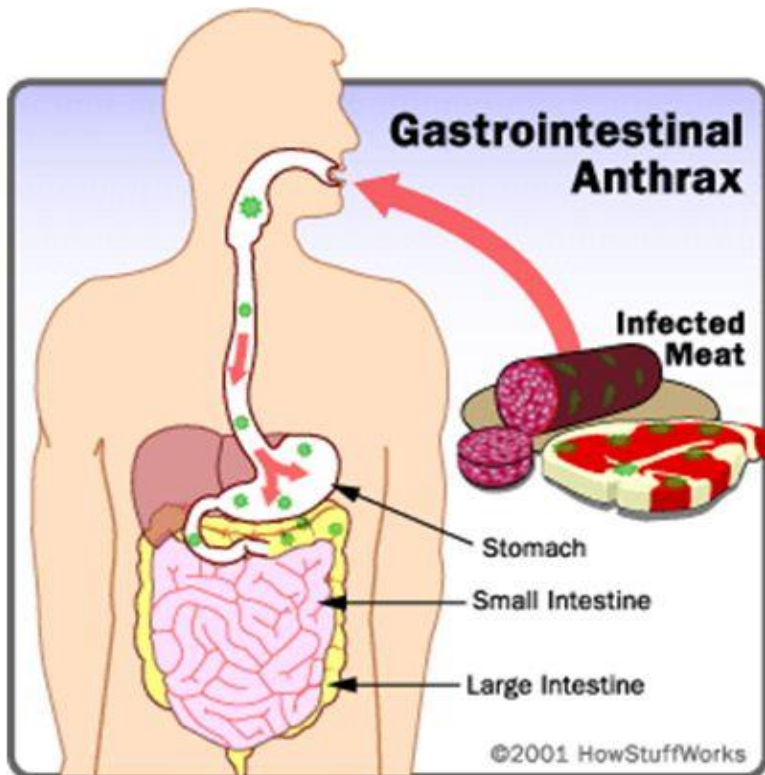
- Most common, occurs when spores come in contact with a cut in skin.
- Symptoms start in 1 - 7 days.
- An itchy sore develops forming blister and then a black painless ulcer, surrounded by swelling.
- A scab forms, dries and falls off within 2 weeks.

Inhalation Anthrax:

- Occurs after inhaling anthrax spores.
- Usually takes 1 to 6 days.
- Enter lungs and release toxic substances causing internal bleeding, swelling, and tissue death.
- Symptoms are fever, shortness of breath, chest pain and shock.



Gastrointestinal Anthrax



- ➔ GI anthrax may follow after the consumption of contaminated, poorly cooked meat.
- ➔ There are 2 different forms of GI anthrax:
 - 1) Oral-pharyngeal
 - 2) Abdominal
- ➔ Abdominal anthrax is more common than the oral-pharyngeal form.

Treatment:

- *The cure depend on a number of factors, including:*
 1. The type of anthrax
 2. How early it is diagnosed
 3. The strain of anthrax bacteria
 4. The patient's age and general health
- *Early treatment with antibiotics and supportive care will improve the chances to cure.*

Prevention

- Public health officials should check places where patient lives and works
- Contaminated surfaces should be disinfected
- People who are exposed should be tested and given prophylactic antibiotics

Avoid infected animals:

- In countries where anthrax is common and animals are not routinely vaccinated, avoid contact with livestock & animal skins
- Avoid eating under cooked meat
- Handle dead animal with care
- Take all essential precautions when working/ processing imported hides, fur or wool

Anthrax vaccine:

- Does not contain live bacteria and is not 100 % effective
- The vaccine is not recommended for children, pregnant women or older adults.
- The vaccine is not intended for the general public but is reserved for military personnel, scientists working with anthrax and people in other high-risk professions.

Animal vaccination

- These programs have reduced animal mortality from this disease drastically and, as cases of animal disease have decreased, human cases resulting from animal exposure have decreased as well.



- ***If a person is suspected as having died from anthrax:***
- *Every precaution should be taken to avoid skin contact with the dead body and fluids exuded through natural body openings.*
- The body should be strictly quarantined & sealed in an airtight body bag and incinerated
- A blood sample should be collected, sealed and analyzed to ascertain if anthrax is the cause of death.

- All contaminated bedding/ clothing should be put in plastic bags and treated as biohazard waste.
- Protective, impermeable clothing and equipment such as rubber gloves, rubber apron, and rubber boots with no perforations should be used while handling the body.
- No autopsy should be attempted without a fully equipped biohazard laboratory and trained personnel.
- *Spores* range from 0.5–5.0 μm in size, one should wear respiratory equipment capable of filtering these.



Thank You!