

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

OCCUPATIONAL HEALTH



السلام عليكم ورحمة الله وبركاته

XI

5th May 2025

PROF. DR. WAQAR AL-KUBAISY

BIOLOGICAL HAZARD



ANTHRAX

Anthrax



- Wool sorters disease, rag sorters disease, malignant pustule milzbrand, and charbon
- is an infection caused by the *Bacillus anthracis*
 - The anthrax bacillus originally gains entry through small breaks in the skin
 - In general, an infected human is quarantined.
 - However, anthrax does not usually spread from an infected human to an uninfected human.
- ❑ In plant-eating animals, infection occurs when they eat or breathe in the spores while grazing
- ❖ Carnivores may become infected by eating infected animals.

Harmful Effects

Local:



At the site of entry **vesicles develop** initially and **progress** to a **depressed black eschar** **ندبة**, at times surrounded by mild to **moderate oedema**. **Pain is unusual.**

Systemic:

- The disease **spreads** from the **local area** through the
- **regional lymph** nodes and **blood stream**, which may result
- in **overwhelming septicaemia** and **death** in untreated cases.
- ❖ **Inhalation** of anthrax spores, causes initial symptoms that are **mild** and **nonspecific** resembling a common **upper respiratory infection**.
- ❖ Respiratory distress, **fever**, and **shock** follow in **3-5 days**,
- ❖ with **death commonly 7 to 24 hours** thereafter

- *Bacillus anthracis* is a rod-shaped, Gram-positive,
- facultative anaerobic bacterium about 1 by 9 μm in size.-
- Robert Koch in **1876** *blood sample from an infected cow, isolated the bacteria, and put them into a mouse.-*

The bacterium normally **in spore form** in the **soil**, and can **survive for decades** or even centuries in this harsh conditions.



- **Herbivores** are often infected whilst grazing,
- especially when eating rough, irritant, or spiky vegetation; *the vegetation has been hypothesized to cause wounds within the GI tract, permitting entry of the bacterial spores into the tissues, though this has not been proven*
- Once ingested or placed in an open wound, the bacteria begin **multiplying inside** the animal or human and **typically kill the host within a few days or weeks.**

The spores germinate at the site of entry into the tissues and then spread by the circulation to the lymphatics, where the bacteria multiply.

Exposure.

The spores of anthrax are able to survive in harsh conditions for decades or even centuries.



Occupational exposure to

- ❖ **infected animals or their products** (*such as skin, wool, & meat*) is the usual pathway of exposure for humans.
- ❖ **Workers who are exposed to**
- ❖ **dead animals and animal products** are at **the highest risk**, especially in countries where anthrax is more common.
- ❑ Anthrax in livestock grazing on **open range** where they
- ❑ **mix with wild animals** still occasionally occurs in the United States and elsewhere.
- **handling infected animals**, their wool, or their hides

Many workers who deal

- Many workers who deal with wool and animal hides are routinely exposed to low levels of anthrax spores, but most exposure levels are not sufficient to develop anthrax infections.

- ❖ A lethal infection is reported to result from inhalation of about 10,000–20,000 spores, though this dose varies among host species.

Little documented evidence is available to verify the exact or average number of spores needed for infection.

Historically, inhalational anthrax was called wool sorters' disease because it was an occupational hazard for people who sorted wool.

Today, this form of infection is extremely rare in advanced nations, as almost no infected animals remain



A lethal infection is reported to result

Occupation occurs

- ❖ Animal Breeder, animal caretaker, animal scientist, butcher, farmer and rancher, مربى الأبقار farmworker, hunter and trapper, laboratory animal worker, meat packer, slaughterer, veterinarian
- ❖ Handling of infected animal carcasses or placental tissues
- ❖ Handling of raw goat hair, wool, or hides from endemic areas



❖ Veterinarians

Risk factors include

- ❖ people who work with animals or animal products,
- ❖ travellers, postal workers, and military personnel.
- ❖ contracted in laboratory accidents or by
- ❖ It has also been used in biological warfare agents and by terrorists

Mode of infection

Anthrax can enter the human body through the

1. G I tract (ingestion),
2. lungs (inhalation),
3. skin (cutaneous)



I Cutaneous anthrax,

- ❖ also known as **hide-porter's disease**,
- ❖ **It is the most common form (>90% of anthrax cases).**
- ❖ It is also the **least dangerous** form
- ❖ (**low mortality with** treatment,
- ❖ Cutaneous anthrax is typically caused when ***B. anthracis***
- ❖ **spores enter through cuts on the skin.**
- ❖ This form is found most commonly when **humans**
- ❖ **handle infected animals and/or animal products.**
- ❖ Cutaneous anthrax **is rarely fatal** if treated,
- ❖ **Without treatment**, about **20%** of cutaneous skin infection

❖ Without treatment, about **20%** of cutaneous skin infection cases progress to **toxaemia** and **death**



❖ **beginning** as an **irritating** and **itchy** skin lesion **boil-like** skin-lesion that eventually **forms** an **ulcer** with a **black centre (eschar)**.



❖ The black eschar often shows up as a large,

❖ **painless**, necrotic ulcer

❖ In general, cutaneous infections **form within the site of**

❖ **spore penetration** between **2 - 5 days** after exposure.

❖ Unlike bruises or most other lesions, cutaneous anthrax

❖ infections **normally do not cause pain**.

❑ **Nearby lymph nodes** may become **infected, reddened,**

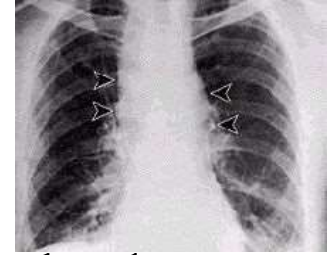
❖ **swollen,** and **painful**.

❖ A dry **crust forms** over the lesion soon, and falls off in a **few weeks**.

❑ Complete recovery may take longer.



II Respiratory infection in humans



❖ Relatively rare and presents as two stages.

It infects the **lymph nodes** in the chest **first**, rather than the lungs themselves, causing **Haemorrhagic Mediastinitis**, therefore causing **shortness of breath**.

❑ The first stage causes **cold and flu-like symptoms**.

▪ Symptoms include **fever, shortness of breath, cough, fatigue, and chills**.

❖ This can **last hours to days**.

❖ **fatalities from inhalational anthrax** are when

❖ the first **stage is mistaken** for the cold or flu and the victim does not seek treatment **until the second stage**,

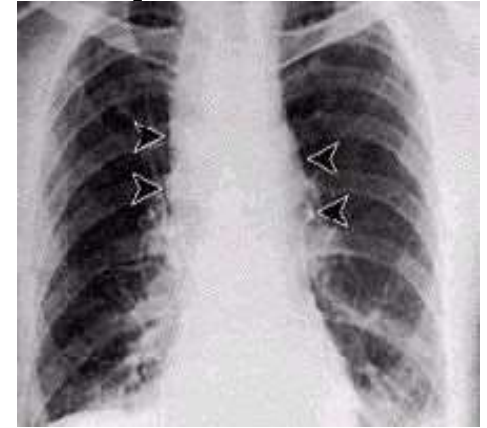
❖ which is **90% fatal**.

❑ The Second (Pneumonia) Stage

❖ occurs when the **infection spreads** from the lymph nodes **to the lungs**.

❖ Symptoms of the second stage develop **suddenly after**

❑ Symptoms of the **second stage** develop suddenly after
➤ **hours or days** of the first stage.



❖ **Symptoms include:**

➤ **high fever,**

➤ **extreme shortness of breath**

➤ **shock, and**

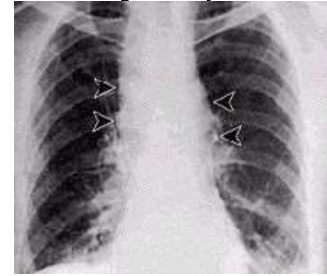
➤ **rapid death within 48 hours** in fatal cases.

❖ **mortality rates were over 85%,**

❖ **Treated early case fatality rate dropped to 45%.**

❖ **Distinguishing pulmonary anthrax** from more common causes of **respiratory illness is essential to avoiding delays in diagnosis** and thereby improving outcomes

❑ **The infection of** herbivores (and occasionally humans) by the inhalational route normally **proceeds as:**



- ❖ Once the spores are inhaled, they are transported into the alveoli.
- ❖ The spores are then **picked up by macrophages** in the lungs and are **transported through lymphatic vessels** to the **lymph nodes** in the mediastinum.
- ❖ **Once in the lymph nodes**, the spores **germinate** into
- ❖ **active bacilli** that **multiply** and eventually **burst the**
- ❖ **macrophages, releasing** many more **bacilli** into the bloodstream to be transferred to the entire body.

*Once in the blood stream, these bacilli release three proteins named lethal factor, edema factor, and protective antigen. The three are **not toxic by themselves**, but their combination is incredibly lethal to humans*

III Gastrointestinal infection (GI)

- ❖ is most often caused by **consuming anthrax-infected meat** and is characterized by
 - diarrhoea, potentially with blood,
 - abdominal pains, loss of appetite.
 - -**Occasional vomiting of blood** can occur.
- ☐ Lesions have been found
 - in the **intestines** and
 - in the **mouth** and **throat**.
- ☐ After the bacterium invades the **gastrointestinal system**,
- ❖ it spreads **to the bloodstream** and throughout the body, while continuing to **make toxins**.
- ❖ **GI infections** can be treated, but usually result in
- ❖ **fatality** rates of **25% to 75%**, depending upon how soon treatment commences.
- ❖ This form of anthrax **is the rarest**.



1V The injection form

presents with **fever** and

an **abscess** at the site of drug injection

□ **Diagnosis.**

Various techniques may be used for the direct identification of *B. anthracis* in clinical material.

Firstly, specimens may be Gram stained

Gram-positive. are not motile, susceptible to penicillin

Diagnosis can be confirmed based on finding

- antibodies or
 - the toxin in the blood or
- indirect hemagglutination,
-linked immunosorbent assay

❖ by **culture** of a sample from the infected site to identify

To confirm the organism is *B. anthracis*, rapid diagnostic techniques such as

2 **PCR**

3. immunofluorescence microscopy may be used.

though **culture of the organism** is still the gold standard for diagnosis.

depending on the part of the body that's affected.

- If skin symptoms, take a **small sample** of the affected skin to test in a lab.
- ❖ **X-ray** of chest or **CT scan** if inhalation anthrax.
- ❖ And a **stool test** in order to diagnose gastrointestinal anthrax.
- ❖ might have **meningitis** caused by anthrax, **CSF test**.

Epidemiology

Anthrax is

- ❖ spread by contact with the bacterium's **spores**, which often appear in infectious animal products.
- ❖ Contact is by **breathing, eating**, or through an area of **broken skin**.
- ❖ **does not typically** spread directly between people
- ❖ Although a rare disease, human anthrax, is **most common** in **Africa** and **central and southern Asia**

It also occurs more regularly

- ❖ It also occurs **more regularly** in **southern Europe** than elsewhere
- ❑ is **uncommon** in **North Europe** and **North America**.
- ❑ **Globally**, at least **2,000 cases** occur **a year**
 - with about **two cases a year** in the **United States**.
- ❖ **Skin infections** represent **more than 90% of cases**.
- ❖ Without treatment,
- ❖ the risk of death from **skin anthrax** is **20%.**
- ❖ For intestinal infection, the risk of death is **25 to 75%,**
- ❖ while **respiratory anthrax** has a mortality of **up to 85%, even with treatment**
- ❖ *Until the 20th century, anthrax infections killed hundreds of thousands of people and animals each year.*
- ❖ **Anthrax has been developed as a weapon by a number of countries.**

Epidemiology Cont.

- ❖ Skin infections represent more than 90% of cases.
- ❖ Without treatment,
- ❖ the risk of death from skin anthrax is 20%.
- ❖ For intestinal infection, the risk of death is 25 to 75%,
- ❖ while respiratory anthrax has a mortality of up to 85%, even with treatment
- ❖ *Until the 20th century, anthrax infections killed hundreds of thousands of people and animals each year.*
- ❑ Anthrax has been developed as a weapon by a number of countries.

Prevention

Certification of imported hides, hair, and wool as anthrax free **by the exporting country** has helped to reduce the incidence of anthrax. In

the **United Kingdom** imported hair and wool are **treated with warm formaldehyde** solution.

In the **United States** the chief preventive measure for high risk industrial **workers is immunization**. **Improved personal hygiene** of workers, **protective clothing**, **ventilation** and housekeeping controls in the plants are also valuable in control of the disease.

❖ **Vaccination** of animals in enzootic areas and **strict adherence** to laws regarding animals who have contracted or who have died of anthrax **have helped reduce agricultural incidence**.

❖ **Precautions** are taken **to avoid** contact with the **skin**



Cont. ..Prevention

- ❖ **Precautions** are taken to **avoid** contact with the **skin** and any **fluids exuded** through natural **body openings** of a deceased **body** that is suspected of harbouring anthrax.
- ❖ The body should be put **in strict quarantine**.
- ❖ **A blood sample** is **collected** and **sealed** in a **container** and **analysed** in an approved laboratory **to ascertain** if anthrax is the cause of death.
- ❖ The body should be **sealed in an airtight** body bag and **incinerated** to prevent transmission of anthrax spores.
- ❖ **Full isolation** of the body is important to prevent possible contamination of others.
- ❖ **Protective, impermeable clothing and equipment** such as **rubber gloves** , **rubber apron**, and **rubber boots** with no perforations are used when handling the body.

No skin, especially if it has any wounds or scratches, should be exposed.



Cont. ..Prevention

- **No** skin, should be **exposed**, especially if it has any
- wounds or scratches,
- **Disposable** PPE is preferable,
 - but if **not available**, decontamination can be achieved by **autoclaving**.
- Used disposable equipment is **burned** and/or **buried** after use.
- All **contaminated** bedding or clothing is isolated in double plastic bags and treated as biohazard waste.
- Respiratory equipment capable of filtering small particles,
- ❖ **Preventive antibiotics** are recommended in those **who have** been **exposed** must be started as soon as possible
- ❖ **Early detection** of **sources** of anthrax infection can allow preventive measures to be taken.

Prevention cont. ..

- ❖ Anthrax cannot be spread directly from person to person, but
- ❖ **person's clothing** and body may be contaminated with spores.
- ❖ **Effective decontamination** of people can be accomplished by a
 - thorough wash-down with **antimicrobial**
 - soap and water.
- ❖ **Waste water is** treated **with bleach** or another **antimicrobial agent**.
- ❖ **Effective decontamination** of **articles** can be accomplished by
 - ❖ **boiling them** in water **for 30 minutes or longer**.
- ❑ Chlorine bleach is **ineffective** in destroying **spores** and vegetative cells on surfaces,
- ❖ though **formaldehyde is effective**.
- ❖ **Burning** clothing is **very effective** in destroying spores.

Antibiotics

Early antibiotic treatment of anthrax is essential; **delay significantly lessens chances for survival.**

Treatment for anthrax infection includes large doses of **intravenous and oral antibiotics**, such as [doxycycline](#), [erythromycin](#) [fluoroquinolones](#) ([ciprofloxacin](#)), , [vancomycin](#), or [penicillin](#).

In possible cases of pulmonary anthrax, early **antibiotic prophylaxis** treatment is crucial **to prevent possible death.**

Many attempts have been made to develop new drugs against anthrax, but existing drugs are effective if treatment is started soon enough.

Vaccine

Anthrax vaccine is approved for adults who may be at risk of coming in contact with anthrax because of their job.

These at-risk adults will receive the vaccine **Before Exposure:**

Certain laboratory workers who work with anthrax

Some people **who handle animals** or animal products, such as some **veterinarians**

- Some members of the United **States military**

- **To build up protection against anthrax,**

- ❖ **5 shots** of anthrax **intramuscular** vaccine **over 18 months.**

- ❖ **annual boosters** should be given

Post-Event Emergency Use

- ❖ In November 2015, FDA also approved the vaccine for
- ❖ **use after exposure to anthrax**

In certain situations, such as a **bioterrorist** attack involving anthrax, anthrax vaccine might be recommended

- **3 shots** of anthrax vaccine
- **over 4 weeks**
- **plus a 60-day** course of **antibiotics**.

One possible approach to **vaccination of animal** is an initial schedule of

- ❖ **two inoculations one month apart,**

A **single annual booster** may be administered thereafter.



Thank you!

Several things to say,
but words get in the way
so I'll keep it simple...

Thank You!

GOOD LUCK FOR YOU