Acute specific surgical infection.

Tetanus. Gas gangrene. Anthrax. Diphtheria of wounds.

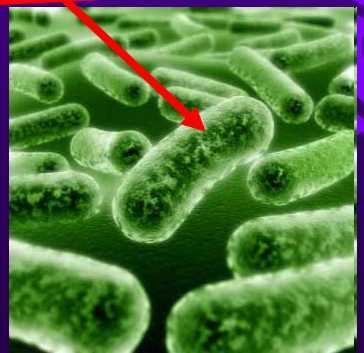
Lecture for general surgery

Chorna I.A.

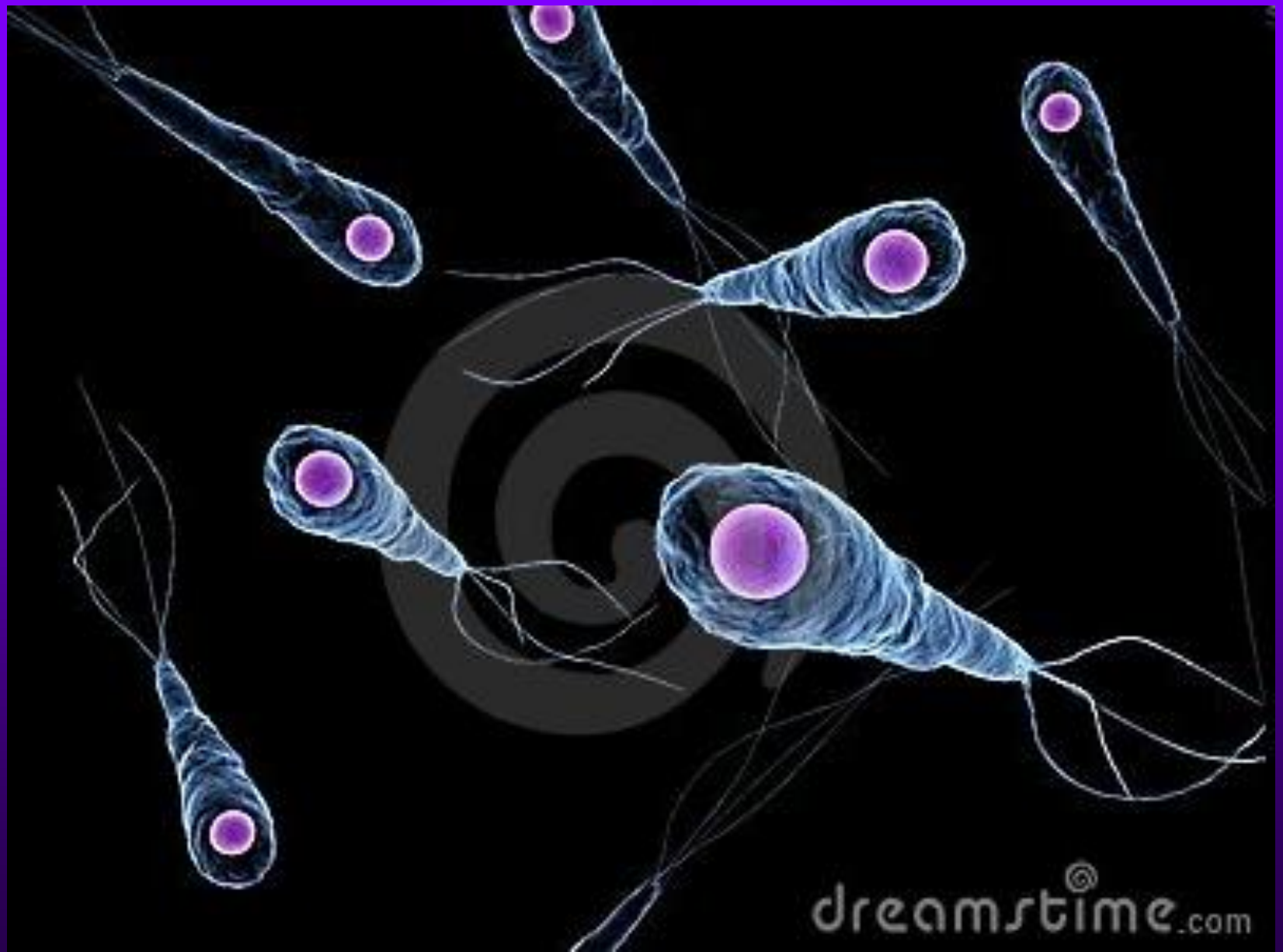
Poltava

Tetanus

- Tetanus is an infectious disease
- caused by contamination of wounds from the bacteria **Clostridium tetani (an obligate anaerobic gram-positive bacillus,),** or the spores they produce that live in the soil, and animal feces.
- Picture of Clostridium tetani, with spore formation (oval forms at end of rods)



Clostridium tetani



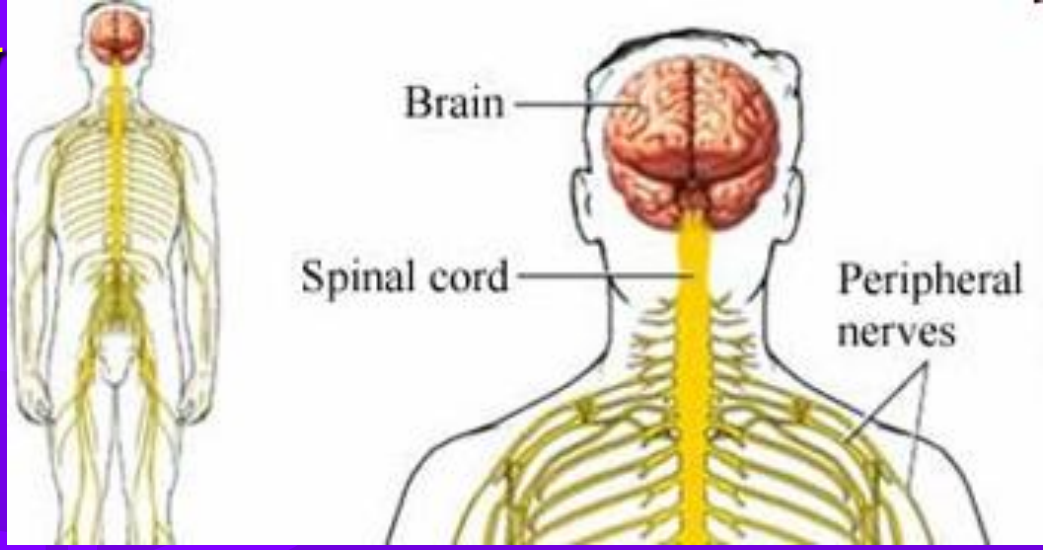
Tetanus bacteria

- Tetanus is caused by a bacterium belonging to the Clostridium genus, which thrives in the absence of oxygen.
- It is found almost everywhere in the environment, most often in soil, dust, manure, and in the digestive tract of humans and animals.
- The bacteria form spores, which are hard to kill and highly resistant to heat and many antiseptics.
- **Puncture wounds are the best entrance for the bacteria into your body**

Other tetanus-prone injuries include the following

- frostbite,
- surgery,
- crush wound,
- abscesses,
- childbirth,
- IV drug users (site of needle injection).
- Wounds with devitalized (dead) tissue (for example, burns or crush injuries) or foreign bodies (debris in them) are most at risk of developing tetanus.
- Tetanus may develop in people who are not immunized against it or in people who have failed to maintain adequate immunity with active booster doses of vaccine.

Pathophysiology of Tetanus:



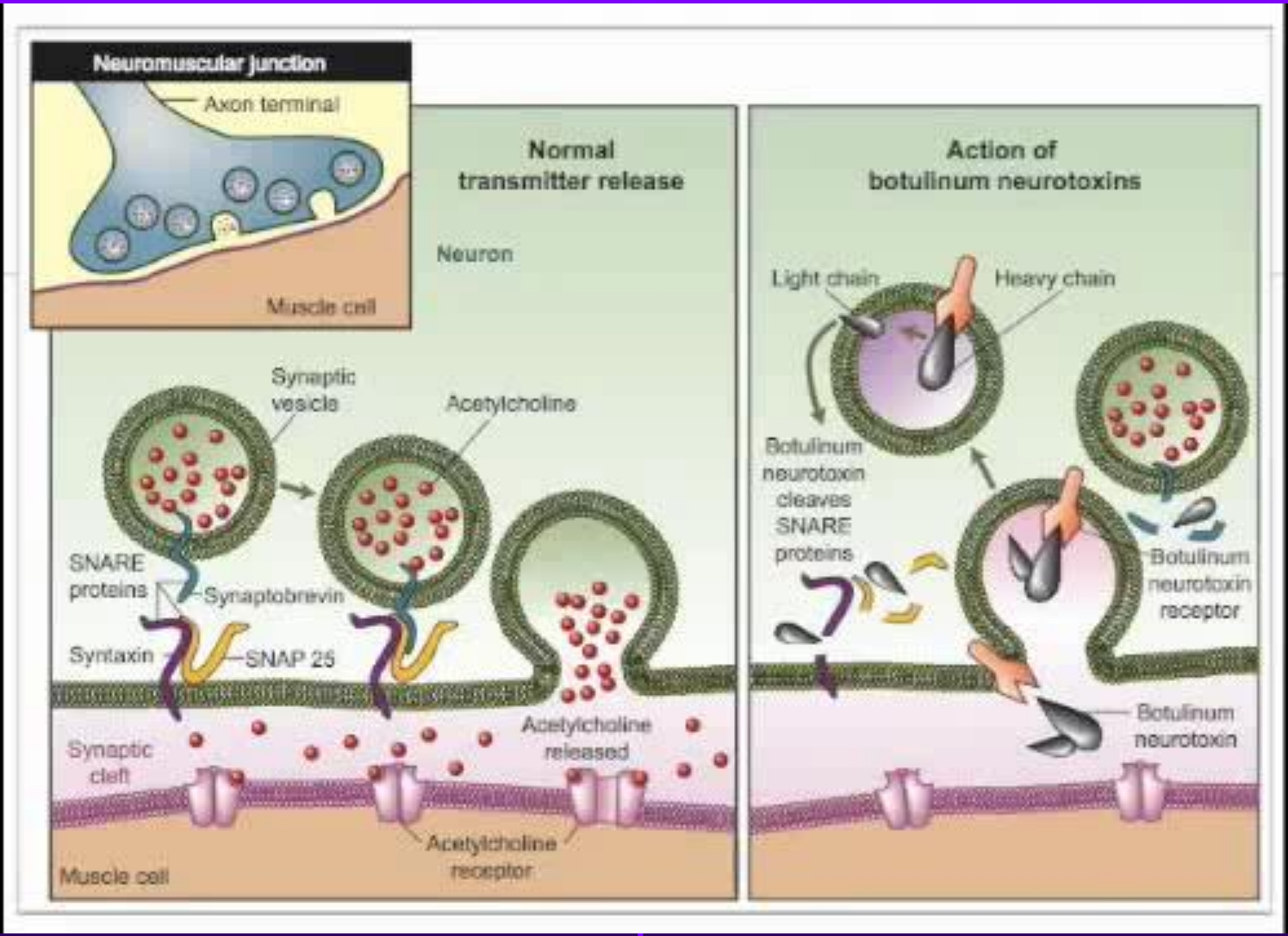
- When a person gets injured, the wound or the cut becomes an environment that lacks oxygen. If the spores manage to find their way into the wound or the cut, they are able to germinate.

After the spores of the bacterium germinate, they release a **exotoxin,** which is what causes all the ill-effects of the disease. It divided on the two parts (fraction):

- The toxin attacks the nervous system of the body. The toxin, which is known as **tetanospasmin,** runs along the spinal cord, the blood stream of the peripheral nervous system and prevents the neuron from releasing the a neurotransmitter that helps the body muscles to relax after a contraction. That is why when a person gets tetanus, he or she suffers from severe spasms and contraction.
- **Tetanolysin** is a hemolytic toxin produced by Clostridium tetani bacteria. Its function is unknown but it is believed to contribute to the pathogenesis of tetanus. The other C. tetani toxin, tetanospasmin, is more definitively linked to tetanus.

- **Tetanospasmin** binds to motor nerves that control muscles, enters the axons (filaments that extend from nerve cells), and travels in the axon until it reaches the body of the motor nerve in the spinal cord or brainstem (a process termed retrograde intraneuronal transport). Then the toxin migrates into the synapse (small space between nerve cells critical for transmission of signals among nerve cells) where it binds to presynaptic nerve terminals and inhibits or **stops the release of certain inhibitory neurotransmitters** (glycine and gamma-aminobutyric acid). Because the motor nerve has no inhibitory signals from other nerves, the chemical signal to the motor nerve of the muscle intensifies, causing the muscle to tighten up in a huge continuous contraction or spasm. If tetanospasmin reaches the bloodstream or lymphatic vessels from the wound site, it can be deposited in many different presynaptic terminals resulting in the same effect on other muscles.

Botulinum + Tetanus Toxin Mechanism



incubation period

The time between infection and the first sign of symptoms is typically 7 to 21 days.

The median incubation period is 7 days, and, for most cases (73%), incubation ranges from 4-14 days.

- The incubation period is shorter than 4 days in 15% of cases and longer than 14 days in 12% of cases.
- Patients with clinical manifestations occurring within 1 week of an injury have more severe clinical courses.

The disease can show four possible types:

- **Generalized** tetanus can affect all skeletal muscles. It is the most common as well as the most severe form of the four types.
- **Local** tetanus manifests with muscle spasms at or near the wound that has been infected with the bacteria.
- **Cephalic** tetanus primarily affects one or several muscles in the face rapidly (in one to two days) after a head injury or ear infection. Trismus ("lockjaw") may occur. The disease can easily progress to generalized tetanus.
- **Neonatal** tetanus is similar to generalized tetanus except that it affects a baby that is less than 1 month old (called a neonate). This condition is rare in developed countries.

Tetanus Symptoms

- Onset may appear to be a mild feverish illness
- Muscular weakness around the cut or wound
- Muscular spasm
- Muscle rigidity, making it impossible to open the mouth. This gives the individual an expression as if they were grinning, and hence "Lockjaw«(тризм)
- Fever
- Rapid pulse with high or low blood pressure
- Saliva production
- Drenching sweats (слюноотделение)
- Spasm of swallowing muscles - may lead to aspiration pneumonia
- Weight loss
- Spasm may increase over time and eventually causes death
- Medical help should sought immediately. Active immunity is gained by being immunized against the organism. It is necessary to get a booster every ten years.

- **The hallmark feature of tetanus is muscle rigidity and spasms.**

generalized tetanus

In generalized tetanus, the initial complaints may include any of the following:

- **muscle cramps,** sore muscles, weakness, or difficulty swallowing are commonly seen.
- Facial muscles are often affected first. **Trismus** or lockjaw is most common.
- A sardonic smile -- medically termed **risus sardonicus**.
- Muscle spasms are progressive and may include a characteristic arching of the back known as **opisthotonus**
- Severe cases can involve spasms of the vocal cords or muscles involved in breathing.

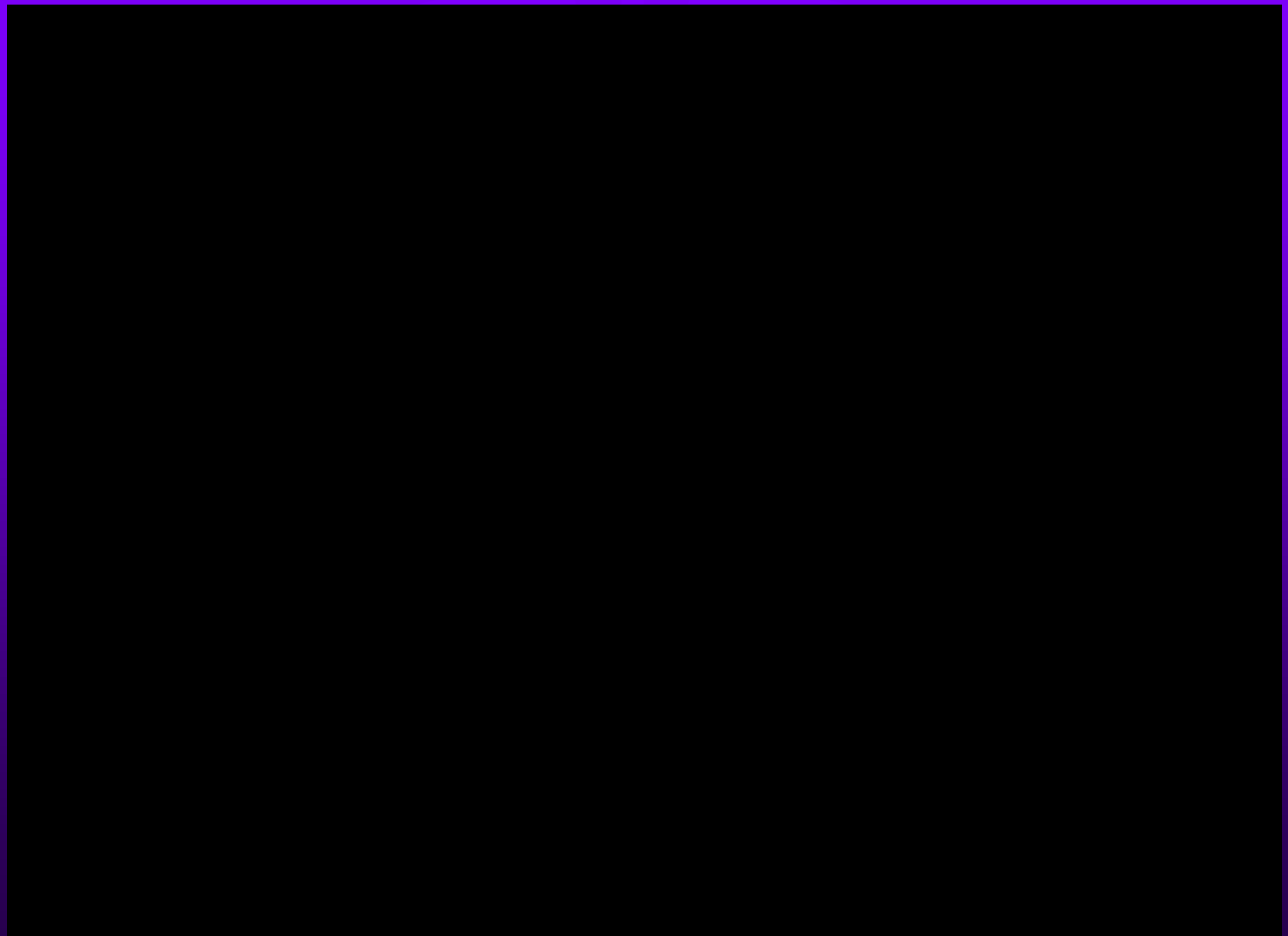
- Irritability, **muscle cramps,** sore muscles, weakness, or difficulty swallowing are commonly seen. Reflex spasms develop in most patients and can be triggered by minimal external stimuli such as noise(шум), light, or touch. The spasms last seconds to minutes; become more intense; increase in frequency with disease progression; and can cause apnea, fractures, dislocations,

and rhabdomyolysis.

- Facial muscles are often affected first. **Trismus** or lockjaw is most common (the jaw is "locked" by muscle spasms,). This condition results from spasms of the jaw muscles that are responsible for chewing. A sardonic smile -- medically termed **risus sardonicus** -- is a characteristic feature that results from facial muscle spasms.

- Muscle spasms are progressive and may include a characteristic arching of the back known as **opisthotonus** Muscle spasms may be intense enough to cause bones to break and joints to dislocate.

Generalized tetanus



cephalic tetanus

- In cephalic tetanus, in addition to lockjaw, weakness of at least one other facial muscle occurs. In two-thirds of these cases, generalized tetanus will develop.
- Cephalic tetanus is a rare form of the disease that is usually secondary to chronic otitis media or head trauma.
- Cephalic tetanus is characterized by variable cranial nerve (CN) palsies(паралич); CN VII is most frequently involved.
- Ophthalmoplegic tetanus is a variant that develops after penetrating eye injuries and results in CN III palsies and ptosis.
- Patients with cephalic tetanus who are untreated progress to generalized tetanus.

Left facial nerve palsy and recent scar in patient with cephalic tetanus

Bilateral trochlear nerve palsy and downbeat nystagmus

Left Infranuclear Facial Palsy

Fig. 1 : On admission, patient showing trismus.

Fig. 3 : Three days after admission, slight reduction in trismus.

Fig. 2 : Left sided infranuclear facial palsy.

Fig. 4 : Seven days after admission, trismus improved with evident left sided infranuclear facial palsy.

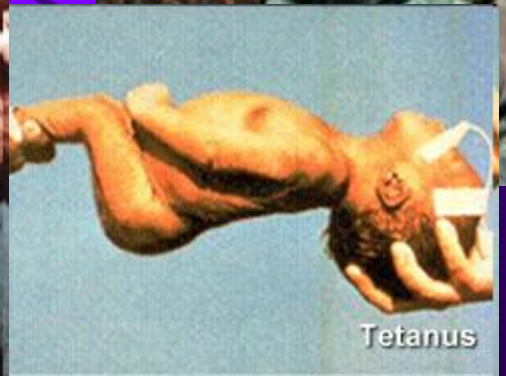
localized tetanus

- In localized tetanus, muscle spasms occur at or near the site of the injury. This condition can progress to generalized tetanus.
- In localized tetanus, pain,

cramps, or muscle spasms occur at or near a recent skin injury This disorder may persist for several weeks but is usually self-limiting.

neonatal tetanus

- Neonatal tetanus remains prevalent in areas of the world where mothers have not been vaccinated and local umbilical cord care is poor.
- Neonatal tetanus is identical to generalized tetanus except that it affects the newborn infant. Neonates may be irritable and have poor sucking ability or difficulty swallowing.



Tetanus Diagnosis

- The diagnosis of generalized tetanus is usually made by observing the clinical presentation and a combination of the following:
- History of a recent injury resulting in skin breakage (but this is not universal; only 70% of cases have an identified injury)
- Incomplete tetanus immunizations
- Progressive muscle spasms (starting in the facial region, especially lockjaw and progressing outward from the face to include all muscles of the body)
- Fever

- Changes in blood pressure (especially high blood pressure)
- Irregular heartbeat
- In localized tetanus, pain, cramps, or muscle spasms occur at or near a recent skin injury.
- Neonates show signs of being generally irritable, muscle spasms, and poor ability to take in liquids (poor sucking response), usually seen in neonates about 7-10 days old.
- Laboratory tests are rarely used to diagnose tetanus. However, some reference labs can determine if the patient has serum antitoxin levels that are protective, and thus a positive test detecting these levels suggests that the diagnosis of tetanus is unlikely.

The spatula test is one diagnostic bedside test.

- This simple test involves touching the oropharynx with a spatula or tongue blade.
- This test typically elicits a gag reflex, and the patient tries to expel the spatula (ie, a negative test result).
- **If tetanus is present, patients develop a reflex spasm of the masseters and bite the spatula (ie, a positive test result).**
- In 400 patients, this test had a sensitivity of 94% and a specificity of 100%.
- No adverse sequelae (eg, laryngeal spasm) from this procedure were reported.

Differentials

- Acute abdominal emergencies
- Conversion Disorder
- Dislocations, Mandible
- Encephalitis
- Hypocalcemia
- Meningitis
- Neuroleptic Malignant Syndrome
- Peritonsillar Abscess
- Rabies
- Seizure disorder (partial or generalized)
- Serotonin syndrome
- Spider Envenomations,
- Widow Stroke,
- Hemorrhagic Stroke (инсульт),
- ischemic (cephalic tetanus)
- Subarachnoid Hemorrhage
- Toxicity, Medication-Induced Dystonic Reactions

Self-Care at Home

- Any wound that results in a break in the skin should be **cleaned with soap** and running water.
- All open wounds are at risk to develop tetanus. Wounds from objects outdoors or crush injuries are at higher risk for getting C. tetani spores into a wound.
- Apply a clean and dry cloth to stop or minimize bleeding.
- Apply direct pressure to the site of bleeding to help minimize blood loss.
- Do not take chances; if the injured person is unsure of their tetanus vaccine status or if the injury may have "dirt" in it, they should visit the nearest emergency care center.

Medical Treatment for Tetanus

Medical treatment has **two aims**:

1. limit growth and eventually kill the infecting C. tetani and thus eliminate toxin production;
2. the second aim is to neutralize any toxin that is formed. If the toxin has already affected the patient, the two aims are still important, but supportive measures will be needed for the patient. These steps are outlined below:

- These steps are outlined below:
- Antibiotics (for example, metronidazole [Flagyl, Flagyl 375, Flagyl ER], penicillin G or doxycycline [Adoxa, Alodox, Avidoxy, Doryx, Monodox, Oracea, Oraxyl, Periostat, Vibramycin, Vibramycin Calcium, Vibramycin Monohydrate, Vibra-Tabs]) to kill the bacteria, tetanus booster shot, if necessary, and occasionally, antitoxin (termed tetanus immune globulin or TIG) to neutralize the toxin

- Wound cleansing to remove any obvious bacteria collections (abscesses) or foreign bodies; if the patient is exhibiting any toxin-related problems, TIG is usually administered first and wound care is delayed for a few hours while the TIG neutralizes toxin because infected wounds, when manipulated, may release more toxin

- Supportive measures
- Pain medicine as needed
- Sedatives such as diazepam (Valium) to control muscle spasms and muscle relaxants
- Drugs used to treat muscle spasm, rigidity, and tetanic seizures include sedative-hypnotic agents, general anesthetics, centrally acting muscle relaxants, and neuromuscular blocking agents.
- Ventilator support to help with breathing in the event of spasms of the vocal cords or the respiratory muscles
- IV rehydration because, as muscles spasm constantly, increased metabolic demands are placed on the body

Tetanus Prevention

- The majority of all adult types of tetanus cases can be prevented by **active immunization**;
- neonatal cases are prevented by good hygiene and careful, sterile technique used to sever the umbilical cord and later (at 2 months old), beginning active immunizations.
- There are two main vaccines recommended by the U.S. Centers for Disease Control and Prevention (CDC).

For pediatric populations, **DTaP (diphtheria, tetanus and acellular pertussis combination vaccine)** is used.

For nonimmunized adults and booster shots, **Tdap (tetanus and reduced amounts of diphtheria and acellular pertussis combination vaccine)** is recommended. Tdap was recommended (by the CDC in 2005) over the older Td combination vaccine, as cases of pertussis (whooping cough) had been increasing in the last decade.

- All partially immunized as well as **unimmunized adults** should receive a **tetanus vaccination** (see below).
- The initial series for nonimmunized adults involves three doses of Tdap:

❖ The first and second doses are given four to eight weeks apart.

❖ The third dose is given six months after the second.

❖ Booster doses are required every 10 years after that.

- In children, the immunization schedule calls for a shot frequency of five doses of DTaP.
- One dose is given at 2, 4, 6, and 15-18 months of age.
- This DTaP series is completed with a final dose when the child is between 4-6 years of age.
- Additional boosters with Tdap are given every 10 years after the final DTaP dose. Children that miss doses of DTaP can be given Tdap doses, but the choice for dose schedule should be determined by the patients' doctor.
- Pregnancy is not considered a contraindication for Tdap or Td vaccine according to the CDC.

- People who **are not completely immunized** and have a tetanus-prone wound should receive a tetanus booster in addition to tetanus antibodies (human tetanus immune globulin or TIG). The tetanus antibodies (TIG) will provide short-term protection against the disease. For patients sensitive to the combined vaccines (DTaP or Tdap), other vaccines against tetanus are available (for example, Td), but the patients' doctor should determine the dosage schedule.

Tetanus Prognosis

- Overall, about 25%-50% of people with generalized tetanus will die.
- The disease is more serious when the symptoms come on quickly.
- Older people and very young children tend to have more severe cases; those over 65 years are more likely to die from the infection
- Intensive medical care improves the prognosis in severe cases.
- Death is usually due to respiratory failure or disturbance of heart rhythm.
- Data on worldwide neonatal deaths is not complete due to poor data collection in many countries; however, several investigators suggest mortality rates range from about 60%-80%.

referens

Gas gangrene

- is a bacterial infection that produces gas in tissues in gangrene. It is a deadly form of gangrene usually caused by ***Clostridium perfringens*** bacteria. It is a medical emergency.

Alternative Names

Tissue infection - Clostridial;

Gangrene - gas;

Myonecrosis;

Clostridial infection of tissues

ethyology

Gas gangrene is caused by exotoxin-producing Clostridial species (most often)

- **Clostridium perfringens**
- **C.histolyticum**
- **C. novyi**
- **C. septicum**
- **C.bifermentans,**
- **C.tertium**
- **C.fallax**
- **C. ramnosum**
- which are mostly found in soil but also found as normal gut flora, and other anaerobes **(e.g. Bacteroides and anaerobic streptococci).**

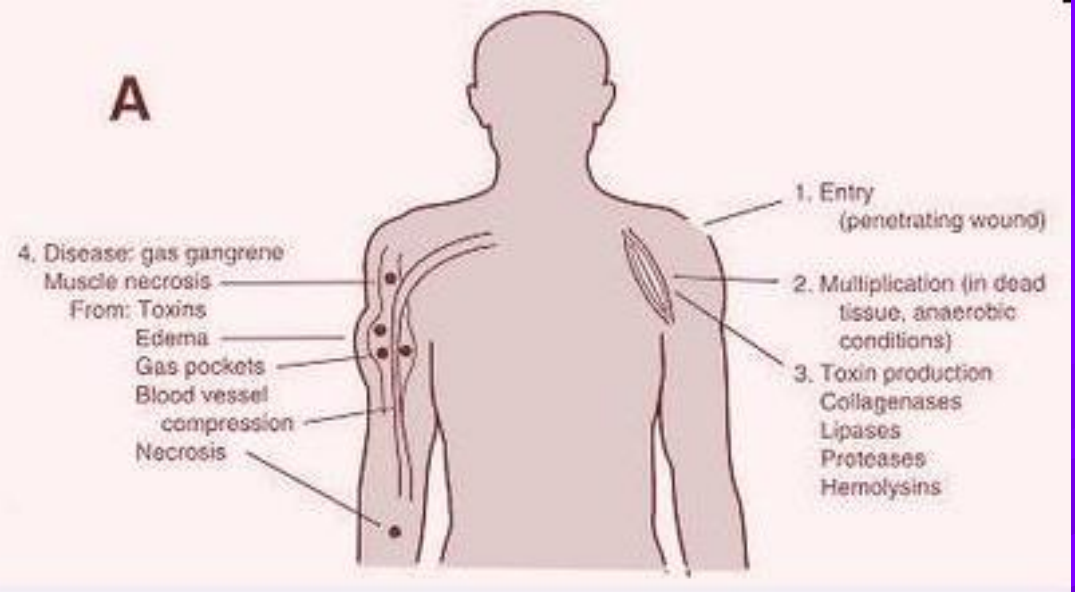
The exotoxin is commonly found in C. perfringens type A strain and is known as alpha toxin. These environmental bacteria may enter the muscle through a wound and go on to proliferate in necrotic tissue and secrete powerful toxins. These toxins destroy nearby tissue, generating gas at the same time.

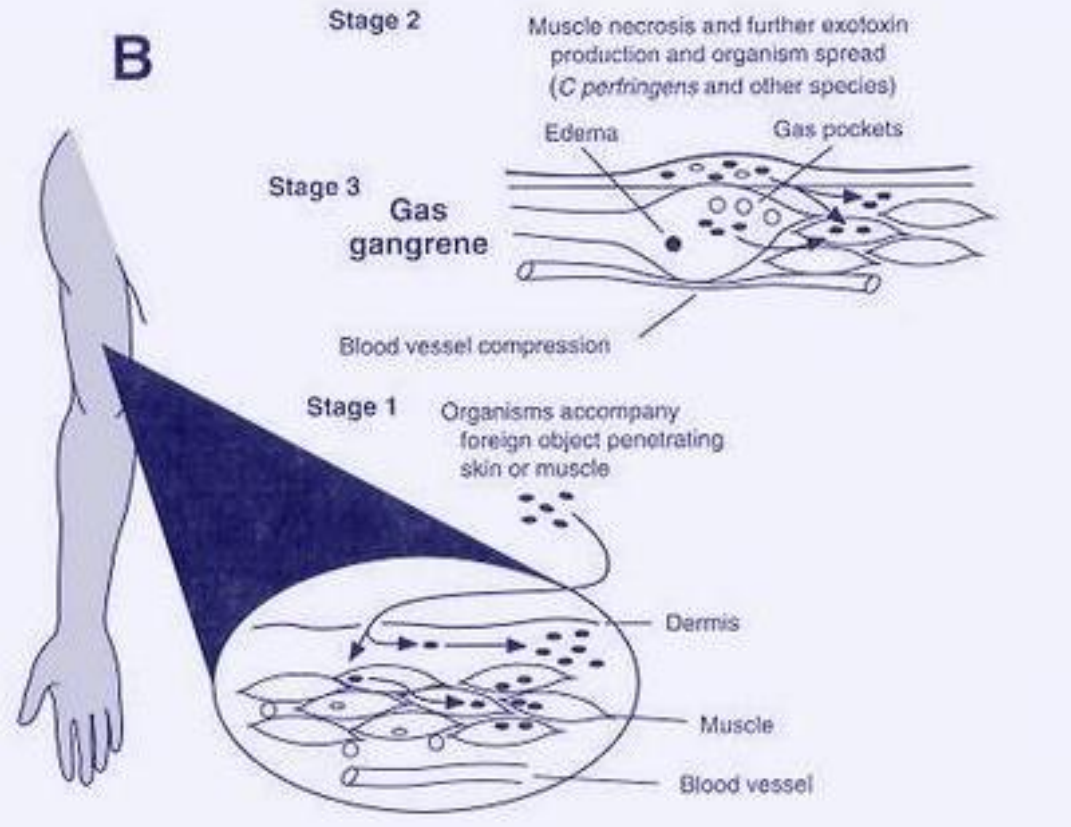
- Other organisms may rarely cause gas gangrene (for example, **Klebsiella pneumoniae** in the context of diabetes).
- A nonclostridial form is caused by a mixed infection of aerobic and anaerobic organisms.

Cultured gas gangrene bacteria

- Gas gangrene bacteria (Clostridium perfringens) colonies (white) being cultured on an agar growth medium (red) in a petri dish.

Pathogenesis of Gas gangrene:





Symptoms include:

- Air under the skin (subcutaneous emphysema)
- Blisters filled with brown-red fluid
- Drainage from the tissues, foul-smelling brown-red or bloody fluid (serosanguineous discharge)
- Increased heart rate (tachycardia)
- Moderate to high fever
- Moderate to severe pain around a skin injury
- Pale skin color, later becoming dusky and changing to dark red or purple
- Progressive swelling around a skin injury
- Sweating
- Vesicle formation, combining into large blisters
- Yellow color to the skin (jaundice)

Note:

- Symptoms usually begin suddenly and quickly worsen.
- If the condition is not treated, the person can develop shock with decreased blood pressure (hypotension), kidney failure, coma, and finally death.
- Gas gangrene is progressive and often fatal.
- The **hallmarks** of this disease are rapid onset of myonecrosis with muscle swelling, severe pain, gas production, and sepsis

risk factors

for the development of gangrene:

- Injury or trauma, such as a crush injury,
- severe burn,
- frostbite
- Diseases that affect the circulation of blood, such as arteriosclerosis, diabetes, smoking, or Raynaud's disease
- Infection of wounds

Atherosclerosis

Colon cancer

Diabetes

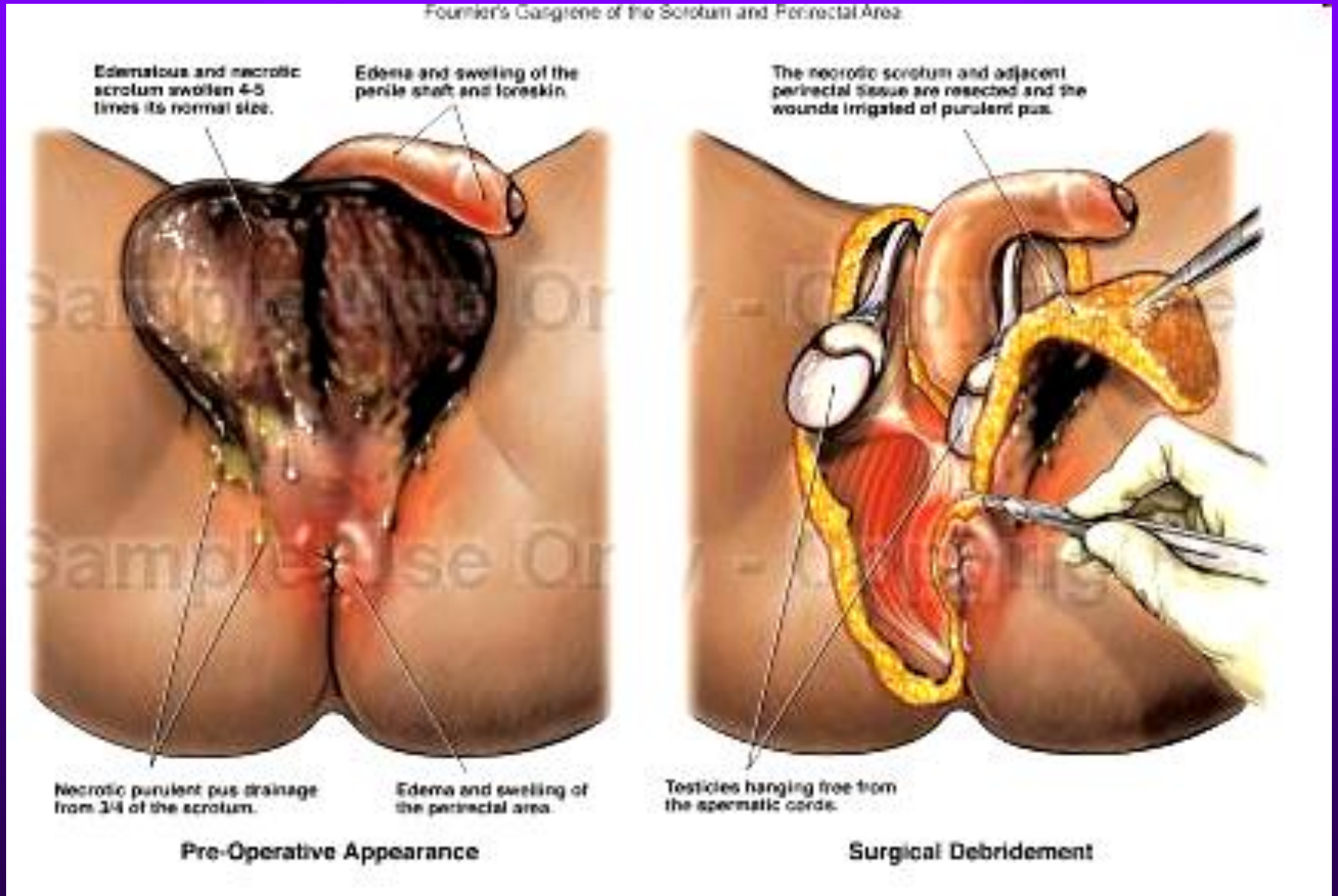
Patients with these diseases are more prone to developing gas gangrene

Exams and Tests

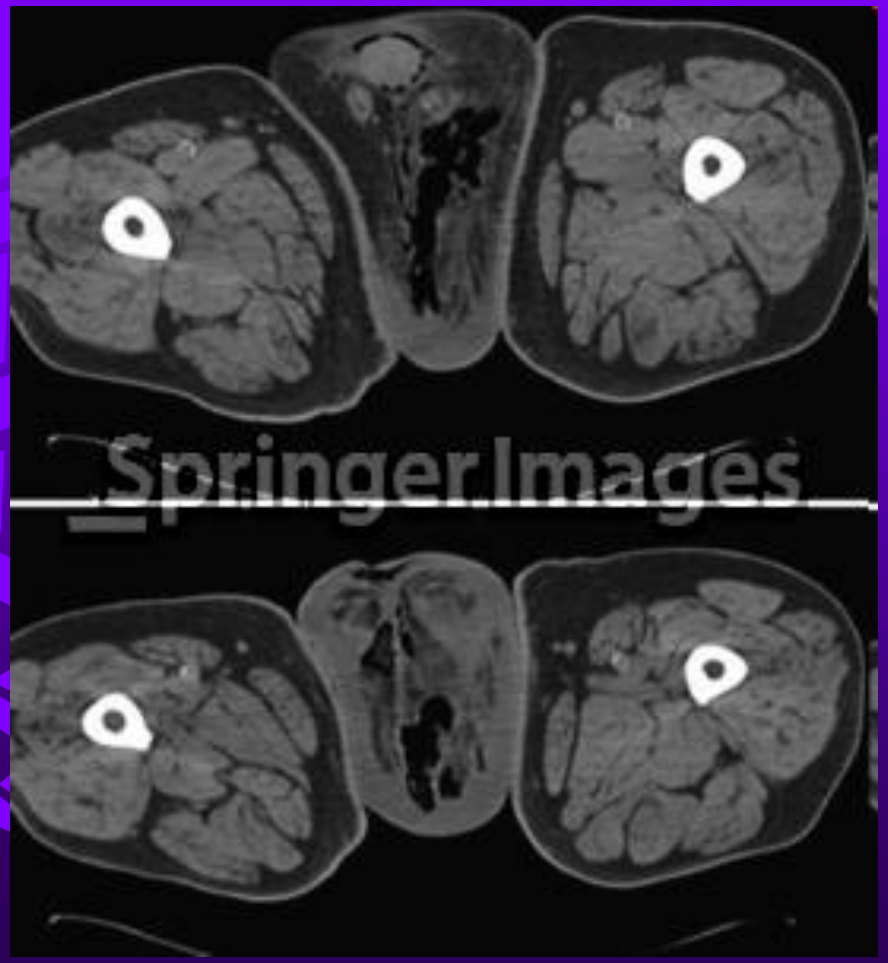
- The person may be in shock. A health care professional might feel air in the tissues (**crepitus**).
- Anaerobic tissue and fluid cultures may reveal Clostridium species.
- Blood culture may grow the bacteria causing the infection.
- Gram stain of fluid from the infected area may show gram-positive rods (Clostridium species) or other bacterial types.
- X-ray, CT scan, or MRI of the area may show **gas in the tissues.**

X-ray

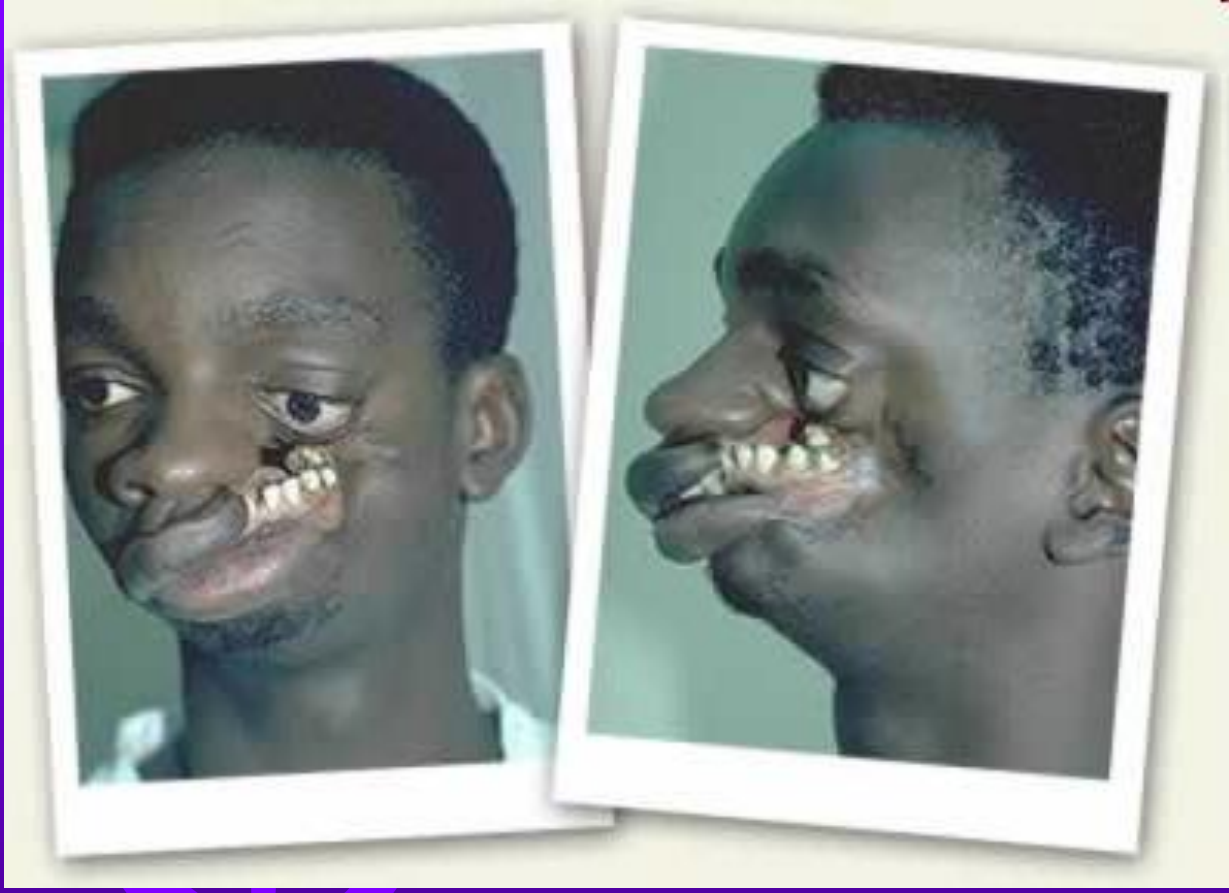
Fournier gas gangrene



- CT images through the perineum in a patient with Fournier gas gangrene. Note the massive scrotal gas and swelling



Noma



- John Botrey lived for 15 years with devastating deformity and disability resulting from the tropical gangrene-like disease, Noma, known as “the face of poverty”

Treatment

- The person will need to have surgery quickly to remove dead, damaged, and infected tissue (debridement). Surgical removal (amputation) of an arm or leg may be needed to control the spread of infection. Often this must occur before all diagnostic test results are available.
- Patients should get antibiotics, preferably cephalosporin-type with clindamycin, carbopenem. Initially, patients receive antibiotics through a vein (intravenously).
- Some people may need analgesics to control pain.
- Doctors have tried hyperbaric oxygen for this condition, with varying degrees of success.

Surgical treatment

a. Intraoperative figure showing necrosis of significant proportions of biceps brachii and the flexors of the forearm.
b. Approximating sutures after broad resection of necrotic tissues of arm and forearm.
c. Postoperative day 50: Healing with granulation of the tissue.
d. Four months postoperatively: Restoration of skin deficits with the use of free skin flaps.

Hyperbaric Chambers Used to Treat Gas Gangrene

Possible Complications

- Coma
- Delirium
- Disfiguring or disabling permanent tissue damage
- Jaundice with liver damage
- Kidney failure
- Shock
- Spread of infection through the body (sepsis)
- Stupor

Necrotizing Fasciitis Part I

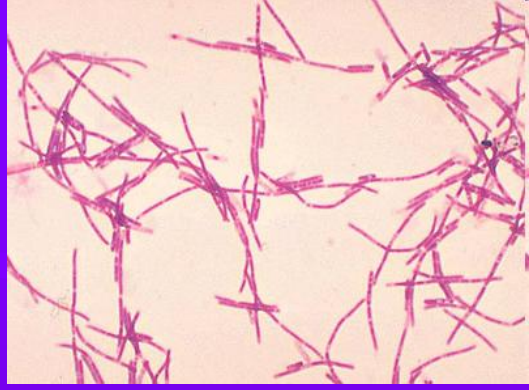
Necrotizing Fasciitis

Difficult Necrotizing Fasciitis Part II

Difficult Necrotizing Fasciitis

Part 2

Antrax



- Anthrax, pronounced as (anthraks), is an acute infectious disease caused by the spore-forming bacterium **Bacillus anthracis**. This rod-shaped microbe grows in soil, where it can be ingested by sheep, cows, horses and goats. Anthrax most commonly occurs in warm-blooded animals, but can also infect humans. Anthrax spores can be produced in a dry form (for biological warfare) which may be stored and ground into particles. When inhaled by humans, these particles cause respiratory failure and death within a week.

Forms of anthrax

- Cutaneous anthrax,
- Inhalation or pulmonary anthrax
- Gastrointestinal anthrax

Cutaneous anthrax

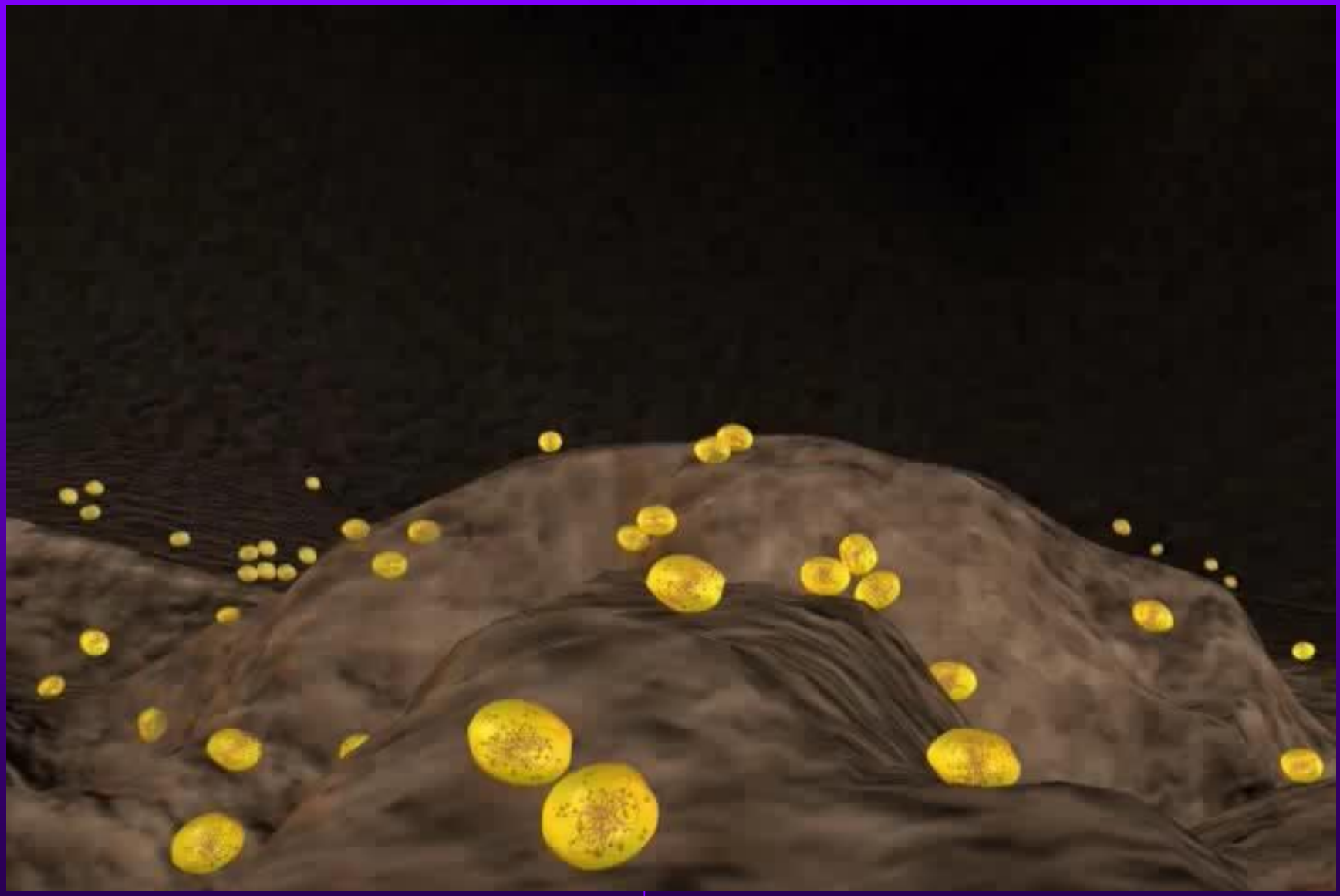
- Cutaneous anthrax, the most common anthrax infection syndrome, occurs when spores are inoculated into the skin through minor abrasions, cuts, or scratches.
- After an incubation period ***of 12 hours to 12 days*** the spores germinate, multiply and produce a toxin that causes an initial lesion resembling a pimple or insect bite.
- Erythema usually surrounds the lesion and satellite vesicular or bullous lesions often develop. Vesicular fluid becomes dark (blue-black) over several days and by the 5th to 7th day the lesion becomes a painless black eschar.

- Blood dissemination (bacteremia) can lead to sepsis and meningitis. Additional complications of cutaneous anthrax include DIC (disseminated intravascular coagulation) with thrombocytopenia and anemia, severe edema (malignant edema) usually involving the face and neck, and secondary bacterial infections causing lymphadenitis or cellulitis.

Symptoms of Anthrax

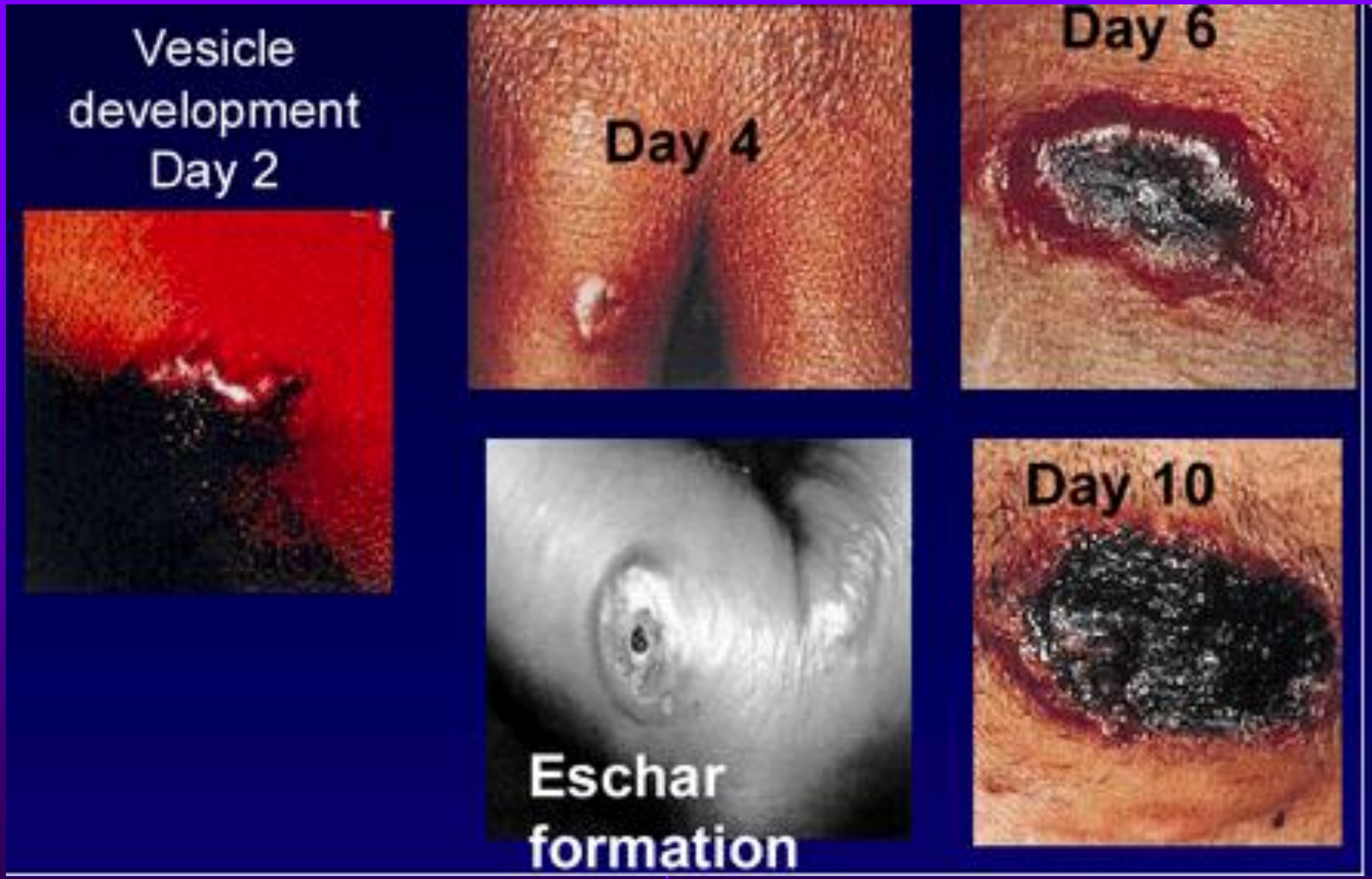
- Symptoms of anthrax an individual may experience vary depending upon the type of exposure.
- Skin exposure: (Cutaneous Anthrax) a boil-like lesion appears on the hands, face, and neck. These lesions eventually forms a black center. A swelling of the lymph gland under the arm may occur. The cutaneous form of anthrax is not usually fatal to humans

Antrax



Cutaneous Pustule of Anthrax

Cutaneous Anthrax.

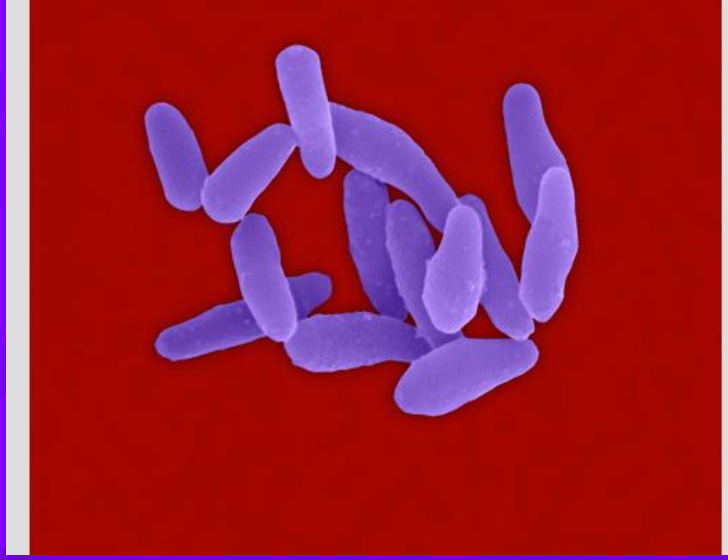


Can Anthrax be prevented?

- Anthrax vaccine is available for people in high-risk occupations. The spread of anthrax can be prevented by: carefully handle dead animals suspected of having anthrax; provide good ventilation when processing hides, fur, hair or wool; and vaccinate animals.

DIPHTHERIA

Diphtheria



Diphtheria is a highly contagious and potentially life-threatening bacterial disease caused by **Corynebacterium diphtheriae.**

There are two types of diphtheria: **respiratory** and **cutaneous**.

Respiratory diphtheria involves the nose, throat and tonsils, and cutaneous diphtheria involves the skin. Cutaneous diphtheria is discussed below.

Diphtheria of wounds (Skin)

- Skin infections with diphtheria are still common in tropical countries and are even more contagious than respiratory diphtheria.
- Skin wounds are characterized by a scaling rash, sores or by blisters which can occur anywhere on the body.
- Skin wounds may be painful, swollen and reddened.
- The skin infection is treated by thorough cleansing with soap and water and appropriate antibiotics.

- A full bacteriological examination, including a virulence test of any diphtheria-like organism that might be recovered, was essential in every case before a diagnosis of cutaneous diphtheria could be made.
- **Diphtheroids or diphtheria-like bacilli** were commonly found in a variety of superficial skin lesions, and it was most important, therefore, that the virulence of all such organisms should be checked.
- On some occasions diphtheritic ulcers could be distinguished by oedema round the wound edges and blackened or yellowish-grey crusts or membrane in the wound, associated with blood-stained sero-purulent discharge and regional lymphadenitis.
- But clinical appearances were variable and the possibility of diphtheria had always to be remembered, when, after apparent initial healing, a wound developed a serous discharge and became necrotic.
- In some serious burn cases diphtheritic infection occurred without the characteristic wound appearances.

Laboratory tests

- The diagnosis of diphtheria can be confirmed by the results of a culture obtained from the infected area. Material from the swab is put on a microscope slide and stained using a procedure called Gram's stain. The diphtheria bacillus is called Gram-positive because it holds the dye after the slide is rinsed with alcohol. Under the microscope, diphtheria bacilli look like beaded rod-shaped cells, grouped in patterns that resemble Chinese characters. Another laboratory test involves growing the diphtheria bacillus on a special material called Loeffler's medium

A diphtheria skin lesion on the leg.

- 

Treatment

Treatment includes a combination of medications and supportive care:

- **Antitoxin**

- The most important step is prompt administration of diphtheria antitoxin, without waiting for laboratory results. The antitoxin is made from horse serum and works by neutralizing any circulating exotoxin. The doctor must first test the patient for sensitivity to animal serum. Patients who are sensitive (about 10%) must be desensitized with diluted antitoxin, since the antitoxin is the only specific substance that will counteract diphtheria exotoxin. No human antitoxin is available for the treatment of diphtheria.
- The dose ranges from 20,000-100,000 units, depending on the severity and length of time of symptoms occurring before treatment. Diphtheria antitoxin is usually given intravenously.

- Antibiotics

- Antibiotics are given to wipe out the bacteria, to prevent the spread of the disease, and to protect the patient from developing pneumonia. They are not a substitute for treatment with antitoxin. Both adults and children may be given penicillin, ampicillin, or erythromycin. Erythromycin appears to be more effective than penicillin in treating people who are carriers because of better penetration into the infected area.
- **Cutaneous diphtheria is usually treated by cleansing the wound thoroughly with soap and water, and giving the patient antibiotics for 10 days.**

Supportive care

- Diphtheria patients need bed rest with intensive nursing care, including extra fluids, oxygenation, and monitoring for possible heart problems, airway blockage, or involvement of the nervous system. Patients with laryngeal diphtheria are kept in a croup tent or high-humidity environment; they may also need throat suctioning or emergency surgery if their airway is blocked.
- Patients recovering from diphtheria should rest at home for a minimum of two to three weeks, especially if they have heart complications. In addition, patients should be immunized against diphtheria after recovery, because having the disease does not always induce antitoxin formation and protect them from reinfection.

Is there a vaccine for diphtheria?

- **Diphtheria vaccine** for children is combined with tetanus and acellular pertussis to form a triple vaccine known as DTaP (diphtheria, tetanus, acellular pertussis). In 2005, a new vaccine was approved as a single booster vaccination for adolescents and adults called Tdap (tetanus, diphtheria and acellular pertussis). Td (tetanus and diphtheria) is also a vaccine used as a booster vaccination in adolescents and adults, however, it does not contain the pertussis vaccine.
- DTaP should be given at two, four, six, 15 to 18 months of age, and between four and six years of age.

- The preferred age for Tdap vaccination is 11 to 12 years. However, all adolescents aged 11 to 18 years should receive a single dose of Tdap instead of the Td for booster immunization if they have completed the recommended childhood DTaP vaccination series and have not received Td or Tdap. An interval of five years between Td and Tdap is encouraged; however an interval of less than five years between Td and Tdap administration can be used. Thereafter, Td should be given every ten years to maintain immunity.
- Adults aged 19 to 64 years should receive a single dose of Tdap to replace a single dose of Td for active booster vaccination if they received their last dose of Td greater than ten years earlier. Thereafter, Td should be given every ten years to maintain immunity.

Isolation of patients

- Diphtheria patients must be isolated **for one to seven** days or until two successive cultures show that they are no longer contagious. Children placed in isolation are usually assigned a primary nurse for emotional support.

Identification and treatment of contacts

- Because diphtheria is highly contagious and has a short incubation period, family members and other contacts of diphtheria patients must be watched for symptoms and tested to see if they are carriers. They are usually given antibiotics for seven days and a booster shot of diphtheria/tetanus toxoid.

Reporting cases to public health authorities

- Reporting is necessary to track potential epidemics, to help doctors identify the specific strain of diphtheria, and to see if resistance to penicillin or erythromycin has developed.


Thanks for your attention!