

AD 672 729

ANTHRAX

A. V. Mashkov

Army Biological Laboratories
Frederick, Maryland

1 July 1968

AD 672729

TRANSLATION NO. *472*

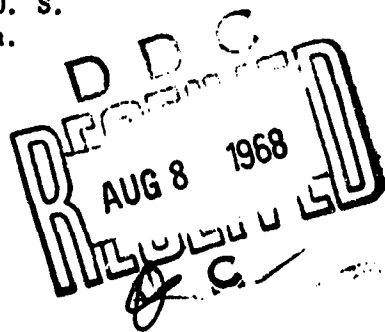
DATE: *July 1968*

DDC AVAILABILITY NOTICE

Qualified requestors may obtain copies of this document from DDC.

~~This publication has been translated from the open literature and is available to the general public. Non-DOD agencies may purchase this publication from the Clearinghouse for Federal Scientific and Technical Information, U. S. Department of Commerce, Springfield, Va.~~

This document has been approved for public release and sale; its distribution is unlimited.



*Department of the Army
Tech Library
Fort Detrick
Frederick Md 21701*

Reproduced by the
CLEARINGHOUSE
for Federal Scientific & Technical
Information Springfield Va. 22151

UNITED STATES ARMY
CHEMICAL CORPS BIOLOGICAL LABORATORIES
Fort Detrick, Maryland

ANTHRAX

by A.V. Mashkov

Translated from the booklet Sibirskaya Yasva (materialy v nemoshch' lektoru) pp 1-36, 1958, Moscow Published by the Ministry of Public Health of the USSR), by SFC Eldon E. Ewing, Technical Library, Technical Information Division.

From the Editors

Human cases of anthrax have become a rare occurrence in the Soviet Union. It is natural, therefore, that not only the population's, but also the doctors' attention to this dangerous infection has lessened. One should not forget, however, that the anthrax infection continues to exist in nature. There are pasture grounds in our huge country where the soil is infected with anthrax spores, and, consequently, the inoculation of animals with this infection is possible here.

Our welfare in the USSR, in regards to the anthrax affiliated with the infected pasture grounds, is made possible by the organization of a government system for antianthrax measures. The success of the latter depends to a large degree on the population's awareness of them. Therefore it is necessary that facts about the anthrax infection and the measures for its prevention have a wide dissemination among the population.

The present brochure contains material for a lecture and also some supplementary points that go beyond the limits of a popular lecture, but which may be of interest to the lecturer and could be used by him, in part, in answers to some of the audience's questions.

1. Material for the Lecture

Introduction

A Disease that afflicts animals and humans, and results in death in the majority of cases, has been known from ancient times. It was noted that man is infected with this disease from sheep - through their hides and wool.

Doctors call sibirskaya yasva (Russian name for the disease-Tr.note) by the Greek word "antraks" (which means "coal") because the necrosed portions of the skin on a patient's body are black. This disease is given various names in different countries. It has been named "siberian ulcer" in Russia because it was particularly widespread in Siberia. But many cases of the disease have also been observed in European Russia.

People have long ago noted that some pastures are unsafe for keeping cattle: anthrax developed with great regularity among the animals pastured on them. The reason for this was still unknown, and such pastures were called "cursed".

For a long time the people knew of no way to contend with the fearful disease, and mass illnesses, which had developed first among the animals and later among the people, took tens of thousands of human lives. It is sufficient to say that in Europe, in 1617, about 60,000 people died from anthrax.

At the start of the 19th century veterinary control groups were created in many countries, including Russia. Although the cause of infectious illnesses remained unknown, still the general sanitary measures, accomplishable by the veterinary workers, led to a decrease in the number of anthrax cases among the animals and, consequently, among the people. Although it was still serious. A real control of infectious diseases, including anthrax, became possible only after the middle of the last century, when the scientists established that these diseases are caused by microbes.

Even in Czarist Russia they started inoculating the cattle against anthrax. This measure gave some effect, but it was conducted only in accordance with personal initiative. For the most part there was no planned systematic control of anthrax, and this disease continued to afflict thousands and tens of thousands of cattle yearly. Because of this the morbidity of the people was high.

With Soviet rule the situation was radically changed. Measures for anthrax prevention became a government function. A system of measures to be adopted for the prevention of anthrax illnesses of agricultural animals and humans was developed on the basis of the achievements of the veterinary and medical sciences. In addition to the veterinary and medical workers the services involved in animal husbandry or products of animal origin were drawn upon for the fulfillment of these measures.

The efficacy of such a system proved to be very high. Our human cases of anthrax became rare occurrences. As a rule, illnesses of agricultural animals are encountered only where the mandatory anti-anthrax measures are carelessly complied with.

The control of anthrax is the business of not just the medical and veterinary workers, but of all citizens having contact with agricultural animals and animal products. For a person to protect himself from the disease he must know how anthrax is transmitted and what must be done to prevent infection. He must also know how this disease develops in man and in animals so that the required measures can be applied in time.

Let us cite two cases of the illness. A collective farm woman's goat died suddenly and she skinned the animal. After a few days the woman's finger began to bother her. Not attaching significance to the fact that the deceased animal had undoubtedly been ill, she limited

herself to self treatment and did not visit a doctor. After a week, when she had become very ill, the patient was brought to the hospital where it was discovered that she had anthrax. But it was too late. She could not be saved.

Another case. A multitude of hard nodules broke out on the fingers of both hands of a Sovkhoz worker a few days after he had been required to kill a cow. Because he knew that it was possible to be infected from a sick animal, he immediately went to the district hospital, where he was given treatment; he soon recovered.

These two examples show the importance of knowing and remembering about the danger of anthrax infection from sick animals.

What Causes the Anthrax Illness and by What Route are People Infected?

Man and animal are infected with anthrax if the microbe that causes this disease penetrates into their organism. The anthrax microbe, which appears as a rod, is distinguished by some special characteristics. The majority of microbes pathogenic to man cannot live long outside a live organism - they are killed by sunlight and by other harmful effects of the exterior medium. Some microbes, however (including the anthrax bacillus), can survive for a long time in unfavorable conditions because they possess the ability to form the so-called "spore".

The spore is formed in the following manner: A portion of the protoplasm (i.e., the protein substance which comprises the microbe's body) condenses and its outer layer is transformed into a thick membrane. The spore's form is round or oval. In distinction from the bacillus the spore requires no food or water from without. The thick membrane protects it from drying and other harmful actions. When it finds itself in conditions of favorable temperature and moisture, in the presence of nutrient substances, it again transforms into a bacillus.

Anthrax spores survive in the soil for tens of years. Having gained admittance into a living organism, where all the favorable conditions for the life of the microbes exist, they again transform into bacilli, which quickly begin to multiply. Right after inoculation the person feels healthy - this is the so-called latent period of the disease. The harmful effect of the microbes is intensified according to their degree of reproduction, and the disease begins to develop.

Man is infected with anthrax from sick animals under varying conditions: through direct contact with sick animals, through products received from them, from bites of some flying insects (horseflies, stableflies).

Direct contact with the diseased animals usually occurs in their slaughter, in the removal of the hide and the dismembering of the carcass. The microbes penetrate into abrasions and small cuts that are on the skin of the hands, and in these places can form one or several carbuncles (the anthrax carbuncle is a hard swelling with a blister in the center). The carbuncles are most frequently formed on the hands and forearms. This is the cutaneous form of anthrax.

In the butchering of meat taken from a sick cow the people are infected principally through a transfer of the infection by dirty hands onto an exposed portion of the body - the face or the neck. With the consumption of poorly cooked meat from an anthrax animal or the consumption of sausage prepared from it, the microbes penetrate into the intestine and the intestinal form of the disease develops.

Hides from anthrax animals and furs that have been prepared from them contain spores. Humans are sometimes infected in the transportation and processing of infected hides and in wearing articles made from them: caps, collars, gloves (mainly home-made articles). The spores can be on the hairs of anthrax animals; therefore, if one should use a shaving brush made from such hairs it is possible to be infected with anthrax; with this the carbuncles formed on the face.

Goat and sheep wool has particularly great importance in the spread of anthrax both in the home and in industry. The microbes can penetrate through abrasions and cuts on the hands and also, upon scratching the skin with contaminated hands, to other parts of the body. In industry the infection occurs most frequently by precisely the latter method. Before, when felt footwear was home made, there were cases of anthrax among the workers engaged in the production of felt boots. Infections from wearing ready-made woolen articles are rare.

Various household articles (dishes, knives, tables, etc.), vehicles and industrial equipment, which have been infected with anthrax spores, can cause human illness of the cutaneous or intestinal form of anthrax, depending on how the articles were used.

In the summer the living infection carriers play a definite role in the spread of anthrax: certain blood-sucking insects, and particularly the horseflies, stableflies and mosquitoes, which transmit the disease pathogen from sick animals to humans and healthy animals. They more frequently bite the exposed portions of the body (face, neck, hands, shins) where the carbuncle then forms.

Besides the cutaneous and intestinal forms of anthrax there exists a pulmonary form of this disease that develops as a result of inhalation of dust containing large quantities of the anthrax spores.

Dust that contains minute solid particles (mineral dust, particles of bristle and hair) that cut the mucous membrane of the respiratory organs is particularly dangerous. The spores in the dust easily penetrate into the small cuts.

Each form of anthrax has its own peculiarities.

What Course Does the Illness Take in Man?

In the cutaneous form of anthrax the carbuncle usually forms on the exposed portions of the body: on the face, neck, hands, less frequently on the legs, and in isolated cases on the portions of the body covered by clothing. The latent period of the disease lasts 2-3 days, sometimes

less than 24 hours, seldom for a week or more. The disease begins with the appearance of a hard swelling (papule) on the skin, where a blister soon forms that gradually enlarges and takes on a dark-red color. The sizes of the blister can reach 5-7 cm. in diameter. The sanguinolent fluid in it contains anthrax bacilli. Around the blister appears an edema, which is sometimes very extensive. At the place of the edema the skin does not redden; it is cold and painless. The blister, too, is painless, but the patient is bothered by itching and he will often tear off the blister by scratching. After a few days a scab is formed at the blister; it gradually grows larger and becomes black, like coal. New blisters are formed around the afflicted area. They burst, dry, and the mortified area is enlarged. The nearby lymphatic nodes are enlarged and painful. The patient feels a general indisposition and weakness. The temperature rises and can exceed 39°C.

With treatment started in time a patient with the cutaneous form of anthrax will recover his health rather quickly. The edema is decreased as early as the second day after beginning treatment, sometimes a little later. The temperature falls to normal and the patient begins to feel satisfactory. After several days the mortified area of the skin falls off, forming an ulcer that gradually heals. The patient remains in the hospital until the healing process is complete.

If the patient had not immediately turned to medical assistance and the treatment had begun late, the disease could have resulted in his death. The reason for this is that the microbes penetrate from the place of the cutaneous affliction into the blood and into the internal organs where they multiply to extremely large numbers and produce an anthracial sepsis. With this the patient's condition is acutely worsened. Nothing can save him, because anthracial sepsis does not respond to treatment. After intense agony the patient dies.

A lethal termination of the cutaneous form of anthrax occurs now in only the extremely neglected cases, when the patient comes to the doctor after the sepsis has already developed. These days, fatal cases do not occur with timely treatment.

The intestinal form of anthrax develops from the consumption of meat products from anthrax animals. These cases are now extremely rare in this country and, as a rule, are connected with the use of products prepared primitively, or at home (sausage, raw smoked meat), thus escaping sanitary inspection. The production of sausage and smoked meat products in government and other centralized enterprises is under constant veterinary and medical supervision, which guarantees their safety.

In the past there were cases of infection through the milk from cows with anthrax.

We have not excluded the possibility of infection through dishes, spoons, knives and other objects of daily use, which have not been disinfected by boiling after use in processing meat from an anthrax animal.

In the intestinal form of anthrax the carbuncle is formed in the intestinal wall. The disease often starts with sharp pains in the stomach. Some patients, prior to this, feel an indisposition: chilliness, headache, and increasing weakness. Then appear nausea, vomiting, sometimes a bloody diarrhea; in other cases - constipation. The temperature rises to 39-40°C. The disease lasts 3-4 days; sometimes the patient dies within 24 hours (children in particular); in other cases the disease lasts 6 days and more. As in the cutaneous form, death comes as a result of anthracial sepsis.

The pulmonary form of anthrax is rarely encountered at present. In the last century it was rather widespread, particularly among the persons engaged in the collection and sorting of rags, and who, due to this, inhaled much dust. Thus it was called "rag-sorter's disease". The discovery of the anthrax microbe helped to establish the true nature of this illness.

After a short latent period the patient begins to feel a breakdown, a tightness in the chest; he develops a cough, chill, difficulty in breathing; the temperature rises to 39-40°C. The disease takes a very severe course. Anthracial sepsis almost always develops and after a few days the patient dies.

In all cases of anthrax the time of applying for medical assistance is of great importance for the result of the illness. The sooner the patient's treatment is started the better his chances for recovery. Therefore, in any illness developing in a person who has had contact with a sick or deceased animal, or with products from an animal that subsequently died, the person should immediately consult a doctor.

Measures for the Prevention of Human Illnesses

A person can be infected with anthrax under production conditions and in their daily life. Consequently we differentiate between the occupational and domestic illnesses. In production the people are either in direct contact with animals (in animal husbandry), or are involved with animal products being subjected to commercial processing. Therefore the occupational illnesses are divided in turn into agricultural and industrial.

Thus, in regards to the genesis and spread of the infection, we distinguish the following three types of anthrax illnesses: agricultural (production), industrial (production), and domestic. In accordance with the different infection routes the measures to be taken also differ with each illness type.

In the agricultural illnesses the infection occurs, as a rule, through direct contact with an anthrax animal in its slaughter, in hide removal, and in the processing of the carcass and entrails. In the overwhelming majority of such cases the cutaneous form of illness develops with the lesions on the hands and forearms. One or several carbuncles develop in scratches or cuts received in the processing of the carcass.

People are sometimes infected while picking berries or walking in meadows or marshes. The areas where the person is infected are often significantly removed from an infected herd, but are within flight range of blood-sucking insects.

Cases of infection caused by the consumption of meat from anthrax animals are very rare because, knowing of the existence of anthrax on the farm the people are usually very careful towards animal products. Milk from sick cows and products prepared from it should not be used, but should be destroyed. During a quarantine the milk from the affected farm is not picked up, but is reprocessed into butter. Upon discontinuance of the quarantine the collected butter is subjected to boiling for two hours under the supervision of a medical worker. The resultant melted butter is then released for consumption.

Objects of domestic use that have been used in the slaughter of an animal and in the processing of its carcass or entrails, are subjected to disinfection, or if they have no value, they are burned. In the apartments of sick people, disinfection is conducted on the linen and other articles that could be touched by the patient's excretions.

Industrial anthrax illnesses. The infection occurs in the processing of technical material of animal origin: wool, hair, hides, bones, horns and hooves. The disinfection of these materials varies in the degree of difficulty entailed. This is explained, for example, by the hairs (wool) having no blood vessels; therefore, during the life of the animal the microbes do not penetrate into their depths. The hair becomes infected by the anthrax spores only on the surface. In the skin, bones, horns and hooves there are blood and lymphatic vessels, into which the bacilli, during anthracial sepsis, penetrate in large number and subsequently transform into spores.

As we have already stated, the spores are found on the surface of hair and wool. This facilitates their disinfection; good results are produced by the use of something as simple as the steam-formalin method.

In view of the fact that the spores penetrate deeply into the depths of the skin, destruction of the spores in it demands stronger methods of disinfection that cause damage to the material and are therefore unadaptable to industry. The tanning industry's technological process includes a processing of the skins (in a lye vat) that kills the anthrax spores. But prior to the placement of the skins into the lye vat there is a processing conducted on the material that has not as yet been disinfected.

Furs cannot be successfully disinfected. Therefore, should there be suspicion of infection by anthrax spores the fur should be burned. The raw material going into the production of bone meal - bones, horns, hooves - must be disinfected by means of boiling or autoclaving.

In the wool-processing industry anthrax illnesses are most frequently encountered in the factories conducting the primary processing of the wool, and chiefly in the dustier shops - those engaged in beating and carding. Wool always contains much dirt, which in the primary

processing settles thickly in the form of dust on the walls of the installation, on the machines, on the clothing and skin of the workers and accumulates under their finger nails. The anthrax spores can be in this dust.

Still, cases of anthrax illness among wool-industry workers are extremely rare. This is because the microbes do not penetrate through undamaged skin; the infection occurs basically in scratches, when the spores reach the abrasions with the dust on the surface of the skin or with the dirt from under the nails. With machinery repairmen or cleaners the spores penetrate into abrasions or cuts suffered while working with the dusty machines. People are much less frequently infected in the transportation of the wool and in other tasks. The finished product (cloth and knitted articles) represents practically no danger in regards to infection with anthrax because in the technological processing the dirt, including the spores, is removed from the material to a significant degree.

The antianthrax measures that are applicable in wool-processing installations are basically included in the following. All workers are protected by special clothing that is kept at the installation in closets separate from the workers' own clothing. The special clothing is changed regularly; it is laundered only after disinfection. The disinfection and laundering are done systematically at the installation and at its own expense. The special clothing is not permitted to leave the installation.

Another important factor is maintenance of body cleanliness. For this, in industry, showers are constructed where the workers wash daily after work. It is necessary to check that the workers clip their nails short because anthrax spores can accumulate beneath them with the dirt. The work rooms must have medicine kits so that accidental skin injuries can be immediately treated.

During the last 4-5 years the workers at installations processing animal materials have been given vaccinations against anthrax (with the "STJ" vaccine). But this by no means relieves the necessity for adherence to the listed general sanitary measures, the usefulness of which has been proved by many years of practice. A planned disinfection of all installations and machines is made several times a year. If one of the workers becomes ill with anthrax the disinfection is made immediately.

Anthrax in the tanning industry. In tanneries the workers are infected most frequently in the sorting and carrying, and in the other pre-production processes. Significantly more infections develop in work with dry skins than in work with the wet-pickled ones. After the preliminary processing of the skins (removal of the hair and scouring) the danger of infection is decreased. Skins coming from slaughter-houses that are protected by veterinary inspection are of no danger in regards to anthrax. The raw material received from anthrax-infested areas is subjected to a special check at the factory (the Ascoli test); therefore, finished articles are rarely the cause of human illnesses. Infection occurs through skin abrasions suffered in carrying hides, or in scratching the skin with contaminated fingernails. The cutaneous form of illness is most frequently encountered.

The measures for the prevention of workers' illnesses are the same as in the wool-processing industry: protection with special clothing, separate storage of the special and the personal clothing, disinfection and laundering of the special clothing in the industry, and prohibition of its removal from the installation. Showers are provided for the workers. Vaccinations are given against anthrax. The production scraps (wool, scrapings, etc.) are burned in furnaces especially constructed in the industry.

Domestic infection with anthrax. As has already been indicated, the infection of people with anthrax in the home can occur through direct contact with a sick animal (slaughter, butchering of the carcass, removal of the hide). There have been cases of infection in the preparation of food from the meat of anthrax animals. In the butchering of the meat the anthrax spores can contaminate articles of household use: a table, a wooden board, etc. If these objects are not later disinfected they can cause infection of people. Let us cite one case as an example: A woman was cutting up mutton on the kitchen table. The sheep, as was later learned, had been ill with anthrax. After a little while the woman's daughter leaned against the table with her bare elbows. After several days she became ill with anthrax, whereupon the carbuncles appeared on both elbows. This case shows the danger presented by household articles that through the carelessness of their owner are not disinfected.

Animal products (wool, hides, hair, etc.) can serve as sources of infection of humans in the home just as in industry. In the home, however, they are more frequently infected through homemade or domestic articles made from animal products.

Sometimes the infection is caused by wearing fur articles - collars, head dresses, gloves or mittens, which are made from the fur of anthrax animals. Old, worn fur articles are the more dangerous (because the spores are in the skin rather than in the hair). In such cases the carbuncles are formed on those areas of the skin where the worn fur pressed tightly against it and caused the wear. In an infection from the collar (sheep or goat) the carbuncle appears on the face or neck; on the forehead - in an infection from a cap; on the skin of the radiocarpal joint in the upper part of the hand - from the fur of the sleeve; and on the fingers and hand - from the gloves or mittens.

Of the woollen goods, kerchiefs, hats and other articles of primitive or home production sometimes serve as sources of infection. Homemade shaving brushes, if made from infected hair, can cause carbuncles on the face, chin, and the front part of the neck; and tooth brushes can cause them in the mouth.

One should not draw the conclusion from what has been said about the domestic infections that every person who wears fur or woollen articles is always in danger of infection. Such cases are extremely rare. But everyone should remember that upon appearance of a hard nodule on the skin at a place of wear or abrasion, he should consult a doctor as soon as possible.

Illnesses caused by food occupy a special spot among the domestic anthrax infections. The infection occurs through poorly cooked meat or the homemade products prepared from it (sausage, etc.), and also through smoked and dried products. From this it follows that the meat from animals which required killing must be well boiled or fried and that it must not be used in smoked form.

With an outbreak of anthrax illnesses of a domestic character, various measures are conducted to prevent the spread of the infection, depending upon the source of infection. If the infection occurred due to contact with the body of a slaughtered or deceased anthrax animal the same measures are conducted that are made with the agricultural outbreaks. The objects through which the infection occurred or which are suspect in this regard are subjected to an effective disinfection (if this is possible) or burned. Fur and leather articles must be burned. Things that are of no great value are also recommended to be burned.

In a patient's apartment after he has been removed to a hospital a disinfection is made of his underclothing and bed linen and also the things that he used. Persons that had contact with the patient are placed under medical observation for a period of 10 days.

In an agricultural area the source of infection is most frequently an animal that was killed of necessity. In such cases it is necessary to find all the pieces of the animal and all the objects that were in contact with it and burn them. That which cannot be destroyed (for example, soil) must be safely disinfected.

The Course Taken by Anthrax in Animals

Not only the agricultural animals - such as large and small horned cattle, horses, asses, mules, camels, deer and swine - contract anthrax, but also some wild herbivorous animals - elk, deer. Carnivorous animals rarely contract the disease, only if a very large quantity of microbes should enter their organism through the consumption of meat from anthrax animals. Birds do not contract anthrax.

The latent period of the disease in animals lasts 1-3 days, rarely to 8 days. The illness develops in the intestinal or cutaneous form, depending on the route of infection.

The basic indications of the disease are as follows. The body temperature rises sharply. The animal becomes sluggish, it is difficult for it to breathe, convulsions appear, the mucous membranes of the mouth, nose and eyes are of a dark red color with a bluish tinge. The stomach bloats. The urine and feces contain blood. Swellings appear on various parts of the body. Prior to death there is very often a bloody discharge from the anus and nostrils.

The following forms of anthrax differ in the gravity of the disease's course. The lightning - like form, in which death comes suddenly within a few hours after the start of the illness, is particularly often encountered in sheep. The acute form lasts 1-2 days and the subacute 2-5 days. There is also a chronic form of anthrax known, which most frequently afflicts

swine. The disease develops in a form of angina with a heavy edema of the larynx. Breathing is made difficult and the animal dies from suffocation.

The mildest form of animal anthrax - the carbuncular - develops through infection from the bites of blood-sucking insects; the illness lasts 5-7 days and recovery can occur even without treatment. This form most frequently afflicts horses.

The body of an animal that has died from anthrax is bloated; rigidity does not occur or is weakly expressed. A frothy bloody liquid, and sometimes a dark blood, flows out of the anus and nostrils. Jelly-like sanguinolent edemata of a yellowish color are found under the skin. The same jelly-like mass is detected in swine beneath the skin in the submaxillary region of the larynx, on the neck. Numerous hemorrhages in the form of blotches of various size are visible under the skin and on the surface of the peritoneum, the intestines, the lungs, the liver, the spleen and the other organs. The blood vessels are filled with a dark uncoagulated blood; the heart and all the muscles are flaccid and of a dark red color. The spleen is enlarged and very flaccid. A sanguinolent liquid is contained in the chest and abdominal cavities. It should be remembered that in the case of a necessary (mercy) killing all of the listed changes in the internal organs may be as yet weakly expressed, particularly if the animal is killed at the start of the disease.

By Which Route Are Animals Infected by Anthrax?

Sick animals are the source of infection, but healthy animals are not infected from them directly. The sick animals discharge the anthrax bacilli with their saliva, urine and bowel movements, thus infecting the pastures, water sources and all the places where they have been and also the objects with which they have come in contact. The infection of the healthy animals occurs through infected grass, straw, other feeds and water.

The bacilli and spores of anthrax can penetrate the mucous membrane of the mouth, particularly that of the throat, and reach the blood, with which it is carried into the internal organs. The infection of animals through the skin is most frequently caused by the bites of blood-sucking insects that have fed on anthrax animals or had contact with their excretions. When the infection is spread by flying insects, after the appearance of the first cases of the illnesses that are related to the consumption of grass on infected pastures, a mass loss of animals begins.

The soil plays an extremely large role in the maintenance of the anthrax infection in nature, because the spores are retained in it for decades. Areas where the soil has been infected, i.e., old cattle graves, single graves, ravines and other places where the bodies of anthrax animals have been buried or deposited, are constant endemic areas for anthrax. The same applies to places where animals die or are slaughtered, the grounds of former tanneries and other installations for the processing of animal material (hair, wool, horns, hooves, bones, etc.) Also, the minor water-supply points in all these areas are usually infected with anthrax spores (ponds, small lakes, brooks, etc.) Cattle can be infected with anthrax through grazing and drinking in these areas.

If the soil and the minor water supplies are infected, then during spring floods and heavy rains the spores can be carried by the water for long distances. Upon reaching inundated meadows and cattle pastures, the spores infect them and anthrax illnesses develop where formerly there had been none. With sufficient moisture and proper temperature (15-20°C) the spores transform into bacilli on the surface of soil that contains nutrient substances (humus). Later, the bacilli that have propagated revert again into spores and thus increase the infectivity of the soil even more. If this occurs on moist inundated meadows then the illness will be spread among the animals through hay that has been collected from them.

Measures for the Prevention of Illnesses of Agricultural Animals

The usual veterinary - sanitary measures are conducted for the prevention of anthrax illnesses among agricultural animals. Let us list the basic measures. Every settlement, kolkhoz and sovkhos must be equipped with a cattle graveyard. It must be constructed on a high, dry area at a distance of not less than one kilometer from human or animal quarters, industrial installations, apiaries, rivers, ponds, wells, springs and other water sources. So that animals have no access to the cattle grave it is surrounded on all sides by an enclosure or wall two meters in height and on the inside by a ditch $1\frac{1}{2}$ meters deep. The ditch is intended for the retention of rain or snow water flowing from the soil of the cattle grave. Locking gates are provided for entrance into the cattle grave, and a bridge is laid across the ditch. For an illustration we present the plans of a cattle grave that we borrowed from F.A. Terent'ev's book.

With the first cases of animal anthrax it is important to identify the disease as early as possible and immediately conduct antiepidemic measures. The sick animals are isolated. The healthy livestock are transferred to different pastures, or if the epidemic developed in the stabling period they are transferred to different barns. A quarantine is placed on the affected farm, and veterinary supervision insures that it is complied with. During a quarantine, movement of cattle to or from the farm and the use of animals for transportation to or from the farm are forbidden. For this period the slaughter of cattle on the farm and removal of meat and milk products from the farm are forbidden. In the area of an outbreak the animals are first given a therapeutic serum that acts quickly, but is of short duration, and then they are given an inoculation, whereby they become immune to the infection (vaccination). In threatened farms where there has not as yet been any illnesses, only the vaccination is conducted.

The destruction of the body of an anthrax animal has a real prophylactic importance inasmuch as the body represents great danger for humans and animals. The best method to dispose of the body is to burn it together with its hide at the place of the animal's death if this does not conflict with the fire regulations. In the opposite case the body should be burned at the cattle grave. The incineration should be complete, until the entire body is changed to ashes.

In the transportation of the carcass to the cattle grave one must take all precautions against scattering the infection. Therefore, one should use a transport with a metal box (for example, a dump truck) or

one that is lined with metal, i.e., one that can be successfully disinfected. Before hauling, the body is liberally sprinkled with repellent solutions (creolin, creosote, carbolic acid) to keep insects away. The animal's anus and nostrils are packed with fiber packing in order to prevent the microbe-containing fluid from emerging through the natural body openings and contaminating the soil or any other objects. The head should be wrapped in an old sack that has been well soaked in the above mentioned repellent solutions. In the absence of a special box for the body it is recommended that it be completely covered with old sacking.

In exceptional cases when it is impossible to burn the bodies it is permissible to bury them in the cattle grave. With this the spores are not destroyed and they will long retain their viability in the soil. The bodies must be buried at a depth not less than two meters. The bottom of the hole is filled with calcium hypochlorite, after which the body is thrown in, and then the upper soil layer on which it lay, and again calcium hypochlorite is poured into the hole over the body and the soil layer. A mound, not less than a half meter in height, is made. All of this takes place under the direct supervision of a veterinary worker.

In places where anthrax animals have been kept a disinfection is made with a 20% solution of calcium hypochlorite (containing not less than 25% active chlorine), with a 10% hot solution of caustic soda, or with a sulfur-carbolic acid mixture. The disinfecting solution is used with a calculation of one liter per square meter in each sprinkling. The disinfection is made three times at one-hour intervals. Contaminated manure, bedding straw and remnants of feed are burned.

II. Methodical Instructions

The content of the lecture must be differentiated in relation to the composition of the audience; taking this into consideration, the lecturer makes the appropriate selection from the material that we have presented. The basic presentation about the developments of the illness, the characteristics of the pathogen, the routes of infection, the measures for its prevention and the importance of early treatment are mandatory for any audience.

It is recommended that examples of anthrax illnesses in the given area or other cases from practice be cited as examples in the lecture. It is useful to cite examples of infection caused by contact with anthrax animals (slaughter of animals, butchering their carcasses, removal of hides); to show the importance of early and late consultation with a doctor; to note the danger of consuming meat from anthrax animals. One should also warn the audience that it is dangerous to buy sausage, smoked meat and other meat products in market places or on the road, because they can cause the intestinal form of anthrax illness.

In an agricultural area the lecturer must pay particular attention to the danger of slaughtering agricultural animals from necessity without the permission of a veterinary inspector, emphasizing the inadmissibility of contamination of the soil and water with the blood, excretions and wash waters from animals butchered from necessity. It is necessary to explain in detail the significance of the prolonged survival of the anthrax spores in soil and water, to tell the importance of keeping the

yard and stable in a good sanitary condition, and also about the rules for maintaining a cattle grave.

In reading the lecture in industry the lecturer must consider it specifically. It is necessary to note the role of the general sanitary measures (dust control, planned disinfection, laundry, disinfection and the storing of special clothes and shoes) and the personal prophylactic measures (separate storage of special and personal clothing, mandatory shower after work, cutting of nails, inspection of hands for the presence of abrasions and scratches, treatment of the latter).

If the lecture is intended for technical and administrative personnel, one should devote particular attention to the disinfection of raw material (wool, hair), the appearance of infected hides, the destruction of industrial wastes and the prevention of contamination of soil and water sources with wastes and scouring waters containing anthrax spores. Further, he should clearly explain the importance of the measures to protect the workers from infection in the industry itself; the arrangement of the showering facilities, the closets for separate storage of special and personal clothing, the organization and conduct of disinfection and laundry of the special clothing, and the protection of each shop with a medicine kit.

III. A Sample Lecture Plan

For a Mixed Audience

1. Introduction (the spread of anthrax in ancient times, in pre-revolutionary Russia and in the USSR; the importance of the government system of antianthrax measures in lowering the morbidity of anthrax).
2. The anthrax pathogen and its characteristics (the vegetative and spore forms of the bacteria; their resistance to disinfectants and high temperature; the protracted retention of spores in soil and water, and the importance of this in the epidemiology and epizootiology of anthrax). Proven methods for disinfection of objects contaminated with anthrax spores.
3. The mechanism for infection of man (through breaks in the skin, bites of blood-sucking insects, alimentary). Domestic infections and measures for personal prophylaxis.
4. Anthrax in man (a short description of the clinic in the cutaneous, intestinal and pulmonary forms of illness). The importance of timely consultation with a doctor and early treatment for the outcome of the disease.

For Agricultural Workers

1. Introduction
2. The pathogen and its characteristics.
3. The types of agricultural animals spontaneously infected with anthrax.
4. The mechanism of infection for agricultural animals.
5. The clinical manifestations of the illness in animals.
6. The clinic of the different forms of anthrax in man (concise data). The importance of timely consultation with a doctor.

7. The necessitated slaughter of animals and its significance in the infection of humans. Measures of personal prophylaxis in the necessitated slaughter of cattle.

8. Antianthrax measures in an agricultural area (vaccination of cattle, veterinary - sanitary measures for the prevention of illnesses and those to be conducted after the appearance of illnesses in agricultural animals).

In an Industrial Installation

1. Introduction
2. The pathogen and its characteristics.
3. The mechanism of infection. The predominant clinical form of anthrax in the given branch of industry (wool-processing, fur, leather).
4. The types of animal material which could be infected with anthrax spores.
5. The preventative measures in industry (dust control, prophylactic planned disinfection of shops and machines, storage and disinfection of special clothing, shower facilities, protection of shops with medicine kits).
6. The measures for the prevention of infected material being used in production (disinfection of suspected wool and hair).
7. The personal prophylactic measures in industry: the proper storage of special clothing, the use of the shower, the cutting of fingernails, the immediate treatment of the most minute injuries to the skin. The danger of scratching the skin with dirty hands. The importance of timely consultation with a doctor upon illness.

IV. Appendix

The Control of Anthrax

A decisive role in the fight against anthrax was played by the discovery of this infection's pathogen and the study of its characteristics. In the middle of the last century (1849-1850) Davaine and Mayer (Davaine and Rayer perhaps? - Tr. note) in France and Pollender in Germany detected huge bacilli in the blood of animals which had died from anthrax. The length of the bacilli was twice the diameter of an erythrocyte. Somewhat later, independently from the mentioned investigators, Brouel (Russia) observed these microbes in the blood of animals ill with anthrax shortly before their death. Davaine established also that the disease is transmitted only by the blood containing the bacilli.

Further successes in the study of the characteristics of the anthrax bacilli were based on the work of R. Koch, who isolated it in a pure culture and demonstrated its etiological significance in experiments on animals. It was later established that anthrax bacilli form spores that are distinguished by a high resistance to various harmful actions; they can retain viability for many years in an external environment, particularly in soil.

Having the possibility to work with pure cultures of anthrax bacilli, the investigators pointed their efforts to a search for a method of weakening the virulence of the cultures for the purpose of producing a vaccine against anthrax. Pasteur (1880), while growing anthrax cultures under conditions of increased temperature (42.5°C), noted that their

virulence was lowered to a degree that animals inoculated with them remained alive and became resistant to infection with freshly isolated anthrax cultures.

These results, which were received in experiments, were verified by Pasteur on agricultural animals. In 1881, on a farm at Pouilly-le-Fort, he immunized 25 sheep and 6 head of large horned cattle with the vaccine. Two weeks after vaccination all of the immunized animals and the same number of control animals were infected with a virulent anthrax culture. All of the immunized animals survived, and all of the control animals died from anthrax. The Pasteur vaccine received wide use first in France and later in other countries. In Russia, Tsenkovskiy, using the Pasteur principle, developed a vaccine that is still used today.

Thus, as early as in the last century science armed practice with not just the methods for diagnosis of anthrax, but also with a successful prophylactic vaccine for the protection of agricultural animals from this infection. In subsequent years improvements were introduced in the production of the prophylactic preparation. In the Soviet era this preparation was improved by Ginsburg (1940), whose vaccine ("STI") gives a dependable effect with a single injection, whereas Pasteur's and Tsenkovskiy's vaccine had to be administered twice. The vaccination of agricultural animals has sharply lowered their morbidity with anthrax, and together with this has lowered the morbidity of humans.

Books and literary materials show that anthrax is encountered in all parts of the world. It is particularly widespread in countries with a developed animal husbandry.

The frequency and intensity of outbreaks depend on the erection of antianthrax measures. Such measures are inadequately conducted in the countries of the Near East (Afghanistan, Iraq, Iran, et al.), and they are unfortunate in regards to anthrax. In the industrial processing of animal materials from the indicated countries it is necessary to take this circumstance into consideration and to strictly observe the prophylactic measures for anthrax at the installations.

Pathological Anatomy

In the external examination of the bodies of humans and animals that have died from anthrax one frequently observes an absence of body rigidity, which is caused by the rapid decay of the tissues. There are the following changes in the internal organs: the spleen is enlarged, filled with blood of a dark red color, and gives a profuse scraping; the liver is blood-filled, sometimes enlarged, and in some cases there are hemorrhages on its surface. The heart muscles are usually flaccid. Hemorrhages are frequently encountered in the myocardium and epicardium. Warty growths can form on the valves. The blood in the heart cavity is fluid and uncoagulated (laky, tar-like). There is a serous or serous-sanguinolent exudate in the heart sac. In the lungs are bronchopneumonic foci with a serous-fibrinous and hemorrhagic impregnation of the tissues. Hepatization and edema of the lungs and hemorrhages and necrosis of the mucosa are observed. Sometimes the foci of affliction have the character of infarcts. The cellular tissue beneath the pleura and also in the mediastinum is edematous and jelly-like. The paratracheal and bronchial

lymph nodes are strongly enlarged, juicy, of soft consistency, and threaded with hemorrhages, thanks to which they have a dark red and sometimes even a black color. Their tissue is strongly changed, permeated with leucocytes and a multitude of bacilli. Carbuncles of various size, up to several centimeters in diameter, can be formed in the intestine. Their consistency is soft, often jelly-like. The color of the carbuncle varies - depending on the period of its development - from a yellowish-gray to a yellow-brown and even red. The surface of the carbuncle is covered with a scab that is later digested, thus forming an ulcer that is surrounded by a broad edema. Sometimes the affliction is expressed by only a diffuse hemorrhagic infiltration with a surrounding edema and without the development of a carbuncle. In the secondary afflictions that develop by the hematogenic route, small hemorrhages are formed without the swelling around them. There is a significant amount of a serous-sanguinolent exudate in the abdominal cavity.

Characteristic pathologic - anatomy changes develop in the brain and its membranes with the anthracial sepsis. The dura mater is strained and blood filled; the sinuses are expanded and filled with a thick dark blood. The pia mater is thickened and of a dark red color; its vessels are expanded and overfilled with blood, due to which one is given the impression of a cap made of blood clots covering the brain ("cap of Hippocrates"). The tissue of the brain is flaccid, blood-filled, of a characteristic crimson color, and contains many petechial hemorrhages.

The most sharply expressed afflictions develop in the organs where the invasion by the anthrax bacilli and their primary propagation occurred. In the cutaneous form first a pustule with hemorrhagic contents appears, and then develops a carbuncle with a hemorrhagic, inflamed infiltration. The carbuncle, for the most part, presents a well defined swelling of a hard, less frequently pulp-like consistency. A scab is formed in the center of the carbuncle from the dried epidermis, the exuded lymph and the Malpighian layer. The skin beneath it is necrotic to a slight depth and the subcutaneous cellular structure is permeated with a jelly-like - serous or fibrinous exudate. The regional lymph nodes are enlarged, of a soft consistency and often have a dark red color as a result of hemorrhagic infiltration. Anthrax bacilli are contained in large number in the contents of the pustule, in the edematous fluid and in the lymph vessels. They are not detected on the surface of the mortified area, but a varied strange flora is encountered. Within the surface layer of the scab the bacilli are encountered in insignificant number, whereupon the greater portion are in degenerate forms. In the deeper layers they have typical form, but often create long chains.

In the intestinal form of anthrax the afflictions are localized primarily in the lower segment of the small intestine, near Bauhin's valve, and in the cecum. They more frequently occur singularly, but are encountered in a number of 20-30 and more, whereupon they are most varied in size. By structure, the foci of affliction are analogous to the cutaneous carbuncle. They x-ray well through the peritoneum and are noticeable on the outer surface of the intestine in the form of red blotches. The mesentery, the omentum, the mesenteric lymph nodes and the retroperitoneal cellular tissue are permeated with blood.

In cases of the pulmonary form of anthrax (primary), in a thorough

examination of the body, one will usually succeed in discovering the entrance routes of the infection in the form of a hemorrhagic-necrotic focus in the nose, in the upper respiratory tracts or in the large bronchi.

In an afflicted lung one notes more or less numerous pneumonic foci, which can cover a significant portion of the organ. There are sanguinolent infarcts and gangrenous foci in the various areas of the lungs. A serous-jellylike infiltration is detected in the interstitial tissue. A serous effusion is contained in the alveoli of the afflicted areas of the lungs, in the pleural cavity there is a serous-hemorrhagic exudate. The primary pulmonary form, as a rule, terminates in anthracial sepsis.

Histological changes. The vascular system, in particular, suffers acutely in anthrax; the capillaries, precapillaries, arteries, veins and lymphatic vessels are affected. Sometimes the larger vessels also suffer. The primary and secondary lesions differ from each other. In the primary lesion the process in the vessels develops principally from the outside toward the interior; the necrosis spreads from the adventitia toward the intima. Vessels are encountered in which the middle and outer membranes are necrotized and the inner layer is stretched in the form of an unusual aneurysm. Ruptures of the intima can occur in the vessels thus changed.

In the secondary afflictions that develop by the hematogenic route the vessels are expanded and overfilled with blood, and a stasis is observed in them. The inner membrane is often necrotized while the middle and outer membranes are completely whole or little changed. The endothelium of the vessels swells, enlarges and peels off. Often one encounters vessels with defects in the wall as a result of necrosis of all its layers. Due to this the formed elements of the blood penetrate through the vessel into the surrounding tissues.

Pathogenesis

The importance of integumental injuries in the genesis of the anthrax infection has been graphically shown by Derishanov in experiments on rabbits. After a preliminary injury to the mucosa of the lower segment of the small intestine (by a needle scratch) Derishanov administered a solution of anthrax bacilli with a syringe into the lumen of the small intestine in its upper segment. At the place of the injury to the animal's intestinal mucosa a typical anthrax carbuncle developed, and at the place of the culture's injection (in the upper section of the intestine) there were no pathological changes except the needle puncture. Derishanov received analogous results in his experiments of administering an anthrax culture into a stomach in which the mucosa had been previously traumatized.

As a result of his observations Derishanov came to the conclusion that the inflammatory process preceding the infection in the intestine contributes to the spread of the anthrax microbe. This is explained by the fact that with the inflammation the integrity of the intestinal mucous membrane's epithelium is disrupted and the anthrax bacilli penetrate into the submucous layer. In the submucous layer the bacilli are protected from the actions of the gastric juice and concurring intestinal microbes, and thanks to the profusion of blood and lymph vessels here they

are assured of nutrient substances. In the presence of such favorable conditions the anthrax bacilli increased multiply in the submucous layer. For them the extracellular fluid is a favorable medium. Within 2-4 hours after infection the vegetative forms that have been developed from spores are already propagating. In anthrax-susceptible animals that have not been subjected to immunisation the propagation of the bacilli continues, and by the time of the animal's death their number amounts to hundreds of millions and billions in a milliliter of blood or in a gram of tissue. In immunized or naturally resistant animals the bacilli die or vanish from the focus of affliction within 2-4 hours after infection.

The factors that affect the encapsulation of the microbes are of essential importance for the development of the anthracial infectious process. In progressive afflictions the majority of the bacilli remain unencapsulated. With the infection of resistant animals the capsules disappear prior to the degeneration and dissolution of the microbes. The pathogenic action of anthrax bacilli, as is evident from the description of the pathological-anatomy changes, is morphologically manifested chiefly in necrotic changes in the membranes of the blood and lymph vessels, which creates the conditions for the multitudinous hemorrhages.

The antigenic substances and the products of the vital activity of the anthrax bacilli show no toxic effect on normal white mice and guinea pigs. During the infectious process they sensitize the organism of an animal or human patient, and at the end of the process, having accumulated in the blood and organs in extremely large quantities, these substances cause a violent reaction of an anaphylactic character that terminates in the death of the host organism.

Immunity

An immunity develops in those who have recovered from anthrax, but it is not life-long. The repeated illnesses encountered among veterinary workers attest to this.

Diagnosis

The identification of the cutaneous form of anthrax presents no difficulties in the majority of cases, thanks to the characteristic picture of the anthrax carbuncle and the edema surrounding it. In some cases it is possible to note a similarity to furunculosis, erysipelas and glanders. But all of these lesions differ from the anthrax carbuncle in that they are painful, and with the presence of edema the skin surrounding them are hyperemic and hot to the touch.

In the visceral forms of anthrax (intestinal and pulmonary), when the local changes are developed in the internal organs and the general manifestations of the disease have no characteristic features the diagnosis is significantly more complex. The epidemiological analysis, which is of such great assistance in the cutaneous form, very often will not suggest a clue as to the nature of the illness in visceral anthrax. The arousal of the doctor's suspicion toward the visceral form of anthrax has a great importance, because it leads to a timely use of the specific therapy that can save the patient's life. The suddenness of the illness and the disparity of the patient's complaints (sharp pains in the abdomen, gravity

of the general condition, or tightening in the chest and difficult breathing) as compared to the objective data that the doctor receives in his examination should suggest the thought of anthrax.

In doubtful cases of the cutaneous form and with the suspicion of the visceral form the problem of the illness's character is solved with the aid of specific diagnostics based on the detection of the anthrax pathogen in the patient's organism.

The anthrax microbe is identified by a series of characteristic features, of which we will indicate the most important. The microbe is a huge bacillus, reaching 5-8-10 μ in length and 1 μ in width. The bacilli are joined together in a chain, the length of which differs according to the conditions of the medium in which they are situated. In the common artificial nutrient media the anthrax microbe grows in the form of long chains consisting of huge unencapsulated bacilli that are undiscernable by their morphology from the huge non-pathogenic bacilli of the anthracoid group. In the animal or human organism the bacillus forms a capsule - a defensive adaptation from the harmful actions on the part of the host organism; it is a covering of a mucous substance surrounding the microbic body. The encapsulated microbes also join into chains, but they are short, consisting of only a few bacilli. These bacilli differ sharply in morphology from the huge non-pathogenic bacilli: their ends are thickened as though they were cut off; they resemble bamboo poles.

In the presence of proper conditions the anthrax bacilli change into the spore form in an artificial nutrient medium or in an external environment. The spore is an oval formation that sharply refracts light and is situated in the center of a cell. Its diameter does not exceed the width of the bacillus. Only one spore is formed from each bacillary cell. Sporulation requires the presence of oxygen, nutrient substances, moisture and a temperature in the 15-42.5°C range (optimal temperature 32-35°C). At a temperature of 12°C the propagation of the bacilli and sporulation cease. If the conditions correspond to those listed, the vegetative forms transform into spores in a relatively short period of time: from 12 hours to several days. In an absence of these conditions the bacilli do not transform into spores, but die. Thus, in an undissected body of an animal or human the spores are not formed and the bacilli die (dissolve) as a result of a lack of oxygen. In the summer this occurs within 1-3 days.

The resistance of the anthrax microbe to harmful external actions differs according to its form. The vegetative form is near to the pathogenic microbes of the intestinal group according to resistance: it is easily killed by the action of common disinfectants (phenol, lysol, etc.) it dies at 60-70°C. In contrast to the vegetative form the anthrax spore is very resistant to external actions. The common disinfectants (mercuric chloride, carbolic acid and lysol) are not used because they act weakly on anthrax spores. A 10-20% solution of calcium hypochlorite, a 5-7% solution of chloramine, or a hot solution of caustic soda are considered effective. These agents are widely used in endemic areas of anthrax.

Boiling will kill spores in a water suspension within 10-20 minutes. It should be taken into consideration, however, that in life the anthrax spores are not encountered in a water suspension, but in protein substances (meat, blood and excretions of a sick animal) that protect them from heat

and increase their resistance.

Practice has shown that in the presence of protein substances a boiling for a period of two hours effectively disinfects objects infected with anthrax spores.

The resistance of spores in the external environment is extremely high. In water they can retain viability for years, and in soil for decades.

The microbe's nutritional requirements are simple. It grows well on weakly alkaline agar and in weakly alkaline broth in aerobic conditions at 15-35°C. Anthrax bacilli can grow on hay infusions, pea stems and extracts from cereal grains and legume seeds.

It is impossible, even in a pure culture, to distinguish the anthrax microbe from the analogous huge non-pathogenic bacilli of the anthracoid group by the cultural and morphological properties. The effective criterion in the recognition of the anthrax microbe is the detection of its pathogenicity. In the laboratories conducting investigations for anthrax they do not limit themselves with a study of the morphology and character of a culture's growth on nutrient media, but without fail inoculate laboratory animals (mice or guinea pigs). The characteristic pathologic-anatomy picture in the dissection of a deceased animal, the detection of encapsulated anthrax bacilli in its blood and internal organs (spleen), and also the detection of their antigen by the precipitation test (Ascoli's reaction) prove the anthracial nature of a test culture.

In the cutaneous form of anthrax the content of the pustule is investigated. A very small amount of formed elements are detected in the smears prepared from it: singular leucocytes are encountered in the field of vision. This phenomenon is caused by the negative chemotaxis of the anthrax bacilli. It should alert the doctor to the possibility of anthrax. In the examination of smears it is easy to detect short chains consisting of 2-4 thick encapsulated bacilli with enlarged ends that appear to be cut off. By their structure the chains resemble a bamboo pole. The bacilli have a characteristic appearance and are easily distinguishable from other bacteria. In staining by the Romanovskiy - Giemsa method the capsule, in the form of a rose colored cover, surrounds the bacillus, which is a dark blue color. On the basis of such a picture it is possible to diagnose the illness as anthrax with complete certainty. In these cases the bacteriological investigation and inoculation of animals are not necessary.

With an incompletely clear picture, for example if it were impossible to find streptobacilli, but at the same time the pustular content was lacking in formed elements, then it is necessary to send the material to a laboratory. It is proper, however, without waiting for the result of the analysis, to start the treatment of the patient in accordance with the clinical manifestations of the disease. With a suspicion of anthrax it is important to remember the serious nature of the infection and the danger of tardiness in specific therapy.

In the subsequent development stages of the disease, when a scab has already formed or a necrotic area has formed at the site where the

pustule had been, the bacteriological investigation is useless because there are no anthrax bacilli on the scab's surface. Anthrax bacilli exist in the depth of the necrotic portion, particularly in its deeper layers, but to extract them from there is absolutely impermissible: a trauma of the scab or necrotic portion of the skin can create conditions for the development of anthracial sepsis, which inescapably leads to the patient's death. It should be noted that in this period of the disease, when a scab or necrotic area is formed, the clinical picture is so clear that a laboratory investigation is not required for establishing a diagnosis.

Early diagnosis is significantly more complicated in the visceral form of anthrax. In the cases where there is suspicion of the intestinal form it should be remembered that large quantities of the anthrax bacilli are excreted with sanguinolent masses from the afflicted portion of the intestine. Therefore, a careful inspection of the feces is necessary to detect bloody admixtures, the bacterioscopic investigation of which makes it possible to establish the nature of the illness. The presence of encapsulated bacilli joined into short chains, which confirms a diagnosis of anthrax, indicates a necessity to immediately begin the corresponding treatment.

In the pulmonary form one observes a discharge of blood clots in coughing. These contain a large quantity of anthrax bacilli. An early diagnosis is also possible in this form of the disease if the patient's sputum is carefully inspected for the sanguinolent admixtures. In questionable cases, with an absence of the sanguinolent admixtures in the feces or sputum, these materials should be sent to a laboratory. Simultaneously the appropriate treatment should be started, taking into consideration that the visceral form of anthrax proceeds faster than the cutaneous, and without specific treatment, as a rule, leads to the death of the patient.

The pathologic - anatomy diagnosis of anthrax has a great practical importance in those cases where it had been impossible to establish the anthracial nature of the patient's disease during his life, and the prophylactic measures for the prevention of the infection's spread had not been conducted. Therefore, in the autopsy of bodies that have died with an uncertain diagnosis, one should carefully examine the internal organs and cavities so as not to overlook morphological changes that are indicative of anthrax.

Those who die from anthrax do not always have the complete picture of the pathologic - anatomy changes described above. Sometimes the changes are limited to small hemorrhages, the presence of an enlarged soft lymph node of a dark color and a hemorrhagic exudate in the peritoneal or pleural cavity. In microscopic investigation of smears from such substrates it is easy to detect the characteristic chains consisting of encapsulated anthrax bacilli.

In outbreaks of anthrax illnesses of the visceral form the first cases are usually diagnosed in autopsy rather than during the patient's life. Consequently, the autopsy plays an extremely important role in the exposure of an infection source in an endemic area.

Treatment

The best therapeutic agent for anthrax is the specific antianthrax serum. It is received from horses which have been hyperimmunized with a live virulent anthrax culture. The efficacy of the therapeutic serum is stipulated by the presence in it of protective "anthracidal substances." Their mechanism of action is included in the following: they destroy the capsules of the anthrax bacilli; the latter are ingested by phagocytes and are thus destroyed. The mechanism of protection of animals immunized against anthrax is the same.

The serum is injected intramuscularly; in severe cases it can be given intravenously. In the absence of "medicinal" serum it is possible to use the veterinary's animal serum. This serum is just as effective as the medicinal, but it is less refined in regards to ballast substances. It should not be shaken before using and cannot be injected intravenously (only subcutaneously or intramuscularly).

It is recommended to inject the serum according to Bixredka's method. In the first injection, 100-150 milliliters are injected. If there is no improvement (drop in the temperature, decrease in the edema, improvement of the general condition) the serum injection is repeated within 8-10 hours and then again on the following day. The total quantity of serum injected can amount to several hundred milliliters, depending on the gravity of the case. One should not fear to inject large quantities of the serum. The patient is in no danger of anaphylactic shock because the serum treatment lasts no more than a few days during which sensitization cannot reach a high degree. The use of the serum can produce a serum illness, but it passes and does not endanger the patient's life.

Neosalvarsan and antibiotics (penicillin, streptomycin) are used as auxiliary agents with the serum treatment. The serum therapy gives a very good result with a localized process. When the process takes on a generalized character and anthracal sepsis occurs, the treatment is ineffective.

Therefore, with a suspicion of anthrax, particularly if there are grounds to presume a visceral form of the disease, it is necessary to proceed with the serum injection as soon as possible.

Literature for the Lecturer

Bashenin, V.A. · A course of peculiar epidemiology. Moscow-Leningrad, 1955, 341-349.

Birger, O.G.; Korobitsyna, L.A.; and Nabokov, V.A.: Material for the epidemiology of anthrax in industrial installations. *Gigiena i Epidemiologiya*, 1927, 4, 51-57.

Gromashevskiy, L.V., and Bayndrakh, G.M.: Peculiar epidemiology. Moscow, 1947, 625-637.

Mikhin, N.A.: Anthrax of man and agricultural animals. Moscow, 1942, 98pps.

Rudnev, G.P.: Zoonoses. Moscow, 1950, 123-143 (The Practical Doctor's Library).

Stanishevskaya, M.B.: Anthrax. In the book: A course on infectious diseases. Edited by S.I. Zlatogorov and D.D. Pletnev, V. 2, Moscow, 1935, 813-842.

Terent'yev, F.A.: Anthrax of animals and its control. Moscow, 1946, 62 pps.

Peculiar epizootiology. Edited by S.N. Vyshelesskiy and F.A. Terent'yev. Moscow, 1954, 5-28.

Yablokov, N.A.: Prophylaxis of anthrax illnesses in industry. Moscow, 1951, 32 pps.

Graphic Aids

Anthrax: Diafil'm. Moscow. Institute of Sanitary Instruction, 1954.

Anthrax: A series of 4 tables with a summary of a lecture. Moscow. Institute of Sanitary Instruction, 1954 (A lecturer's guide).

Illustrations

Fig. 1. Cattle graveyard

Fig. 2. Cattle graveyard