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ANTHRAX (LECTURE AIDS)

By A. V. Mashkov

-USSR-

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FOREWORD

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From The Editors

In the Soviet Union anthrax among humans has become a rare phenomenon. It is therefore natural that the attention not only of the public but of physicians toward this dangerous infection should not decrease. However, one should not forget that anthrax infection continues to exist in nature. On the territory of our enormous country certain pastures occur, the soil of which is infected with anthrax spores and consequently the infection of livestock with this disease is possible. Success in fighting anthrax with the existence of infected grazing lands is caused by the organization in the USSR of a system of anti-anthrax measures. The success of the latter depends to a great degree on the conscientious attitude of the public toward them. It is therefore essential to disseminate broadly among the public information on anthrax infection and on measures for preventing it. This booklet contains material for lectures as well as certain supplementary information which go beyond the framework of the contents of a lecture for the public, but which will be of interest for the lecturer and can be used by him partly for answers to certain questions which may be brought up by the audience.

1. Lecture Materials

Introduction

From ancient times men have known of a disease which has decimated animals and the human population and which in the majority of cases has ended in death. It was noted that man is infected with this disease from sheep -- through their skin and wool. The Greek word is "anthrax" (meaning "coal") in view of the fact that the dead sections of skin appearing on the body of the patient are black in color. In various countries this disease has been given various names. In Russia it was called the "Siberian ulcer", since it was particularly common in Siberia. But many cases of anthrax were also observed in European Russia. The people noted long ago that certain pastures were dangerous for raising stock: cases of anthrax among the livestock raising on these pastures occurred with great regularity. The reason for this was not known, and such pastures were called "cursed". For a long time people did not know how to combat this terrible disease, and mass infections of anthrax, occurring at first among livestock and later among humans,

claimed tens of thousands of human lives. It is sufficient to state that in 1617 about 60,000 persons died from anthrax. At the beginning of the nineteenth century in many countries, including Russia, veterinary supervisory organs were formed. Although the reason for the occurrence of infectious diseases was not yet known, nevertheless general sanitary measures carried out by veterinary workers led to a decrease in the number of cases of anthrax among livestock and, consequently, among humans. However, the incidence was still quite large. Genuine combat against infectious diseases, including anthrax, became possible only in the middle of the last century, when scientists established that these diseases were caused by microbes. In Tsarist Russia they began to vaccinate livestock against anthrax. This measure produced certain results but it was carried out only on private initiative. The most important thing was that planned systematic combat was not carried out against anthrax, and this disease continued to claim thousands and tens of thousands of head of livestock yearly. In view of this, incidence among humans was also high. The situation changed radically under Soviet rule. Measures for preventing anthrax became a state matter. On the basis of the achievements of veterinary and medical science, a system of measures was developed for preventing anthrax in domestic stock and humans. In order to carry out these measures, in addition to veterinary and medical workers, departments were brought in which had a relationship to animal husbandry or animal products. The effectiveness of this system of measures was extremely high. The occurrence of anthrax among human beings became a rare phenomenon. As a rule infection of domestic stock takes place only where a careless attitude is manifested toward the fulfillment of compulsory anti-anthrax measures. Combatting anthrax is the business not only of medical and veterinary workers but of all citizens coming into contact with domestic animals and livestock products. In order for a person to be able to protect himself from infection, he should know how anthrax infection occurs and what should be done in order to prevent infection. It is also necessary to know the symptoms of this disease in man and in livestock in order to take the necessary measures in time.

We shall describe two cases of this disease. The goat of a female kolkhoz member died, and the woman skinned it. A few days later a finger on the hand of the woman began to hurt. Without attributing any significance to the fact that the dead animal had doubtlessly been sick, she did not go to a doctor and limited herself to treating it as best she could. In a week, when she became extremely sick, the patient was taken to the hospital, where anthrax was confirmed. It was too late -- it was impossible to save her

life. Here is another case. A kolkhoz worker, a few days after he was forced to slaughter a cow, began to manifest many dense welts on both hands. Since he knew that it was possible to become infected from a diseased animal, he immediately went to the district hospital where he was given treatment; he soon recovered. These two examples show how important it is to know and remember the danger of the infection of anthrax through diseased animals.

What Causes Anthrax and How Humans are Infected With It

Human beings and animals become infected by anthrax if the microbe which causes this disease penetrates into their organism. The anthrax microbe, which has the appearance of a bacillus, is distinguished by certain characteristics. The majority of microbes which are pathogenic for man cannot live for an extended period outside the living organism -- they perish from sunlight and other influences of the external environment which are harmful to them. But certain microbes (including the anthrax bacillus) can live for a long period of time under unfavorable conditions, since they possess the ability to form a so-called "spore". The spore is formed in the following manner: Part of the protoplasm (that is, the albumen of which the body of the microbe consists) thickens and its external layer is transformed into a dense coating. The spore has a round or oval form. As opposed to the bacillus, the spore does not need to receive food and water externally. The thick coating protects it from drying out and other harmful influences. Under conditions of favorable temperature and moisture, with the presence of nutrients, it once again is transformed into a bacillus. Anthrax spores are preserved in the ground for decades. Coming into contact with a living organism which contains all the favorable conditions for the life of the microbes, they once again are transformed into bacilli, which begin to multiply rapidly. For a while after the infection, the patient feels fine -- this is the so-called hidden period of the disease. As the microbes multiply their harmful action is increased, and the disease begins to manifest itself. A human is infected with anthrax from diseased animals under various conditions: through direct contact with diseased animals, through products obtained from them, through bites by certain flying insects (horse-flies, stable flies).

Direct contact with anthrax infected animals usually takes place during forced slaughter, in removing the skin and cutting up the carcass. The microbes penetrate through scratches and small wounds on the arms, and one or several

carbuncles (anthrax carbuncle -- a large swollen spot with a pustule in the center) can form on these spots. Most often carbuncles form on the hands and forearms. This is the skin form of anthrax. In cutting up meat obtained from a diseased animal, humans are infected chiefly by transfer of the infection by dirty hands to open parts of the body -- the face or neck. In the consumption of poorly cooked meat from anthrax-infected animals or from sausage prepared from it, the microbes penetrate into the intestines, and the intestinal form of the disease appears. Pelts from anthrax-infected animals and the furs prepared from them contain spores. Humans sometimes are infected in transferring and processing infected pelts and in carrying products made from them -- caps, collars, mittens (chiefly hand-made goods). Spores can be found in the hair of anthrax infected animals; therefore, if one uses a shaving brush made from these hairs it is possible to become infected with anthrax, and the carbuncle forms on the face. Goat hair and wool are particularly significant in the spread of anthrax both at home and on the job. Microbes can penetrate into the body by means of scratches and small wounds on the arms, as well as by scratching the skin on other parts of the body with dirty hands. Infection occurs on the job most often by the latter method. Formerly, when felt footwear was produced by hand, there were cases of anthrax infection of workers engaged in producing felt boots. Infection caused by wearing finished wool articles is rare. Various domestic objects (dishes, knives, tables, etc.), means of transportation, implements of production, infected by anthrax spores, also can cause the infection in humans of skin or intestinal anthrax, depending on how these objects were used. In summer living carriers of the disease play a definite role in the spread of anthrax: these are certain bloodsucking insects, particularly horseflies, stable flies and mosquitoes, which transmit the pathogene from the diseased animals to humans and healthy animals. They usually sting uncovered parts of the body (face, neck, arms, shins), upon which the carbuncle forms. In addition to the skin and intestinal forms of anthrax, there exists a pulmonary form of this disease, which arises as a result of breathing in dust which contains large quantities of anthrax spores. Particularly dangerous is dust containing small, hard particles (mineral dust, particles of bristle and hair), which injure the mucous membranes of the breathing organs. The spores contained in the dust usually penetrate into the wounds. Each form of anthrax has its characteristics.

How the Disease Progresses In Humans

In the skin form of anthrax the carbuncle forms chiefly on exposed parts of the body: the face, neck, arms, less often on the legs and sometimes on parts of the body covered by clothing. The latent period of the disease lasts two to three days, sometimes less than 24 hours, seldom a week or more. The disease begins with the appearance on the skin of a thick nodule (papule), in which a pustule soon forms, which gradually increases in size and takes on a dark red hue. The size of the pustule can reach five to seven centimeters in diameter. The bloody liquid in it contains anthrax bacilli. Andoedema appears around the pustule, sometimes quite extensive. On the site of the oedema the skin does not turn red, it is cold and is not painful. The pustule is also not painful, but the patient is often bothered by itching and often he breaks open the pustule upon scratching it. In a few days a scab forms on the site of the pustule, and it gradually increases in size and becomes black as coal. New pustules arise around the dead section, and these burst, dry up, and the size of the numb area increases. The closest lymphatic knots become distended and painful. The patient experiences a feeling of general lethargy and weakness. The temperature rises and can reach 39°C and higher. If treatment is begun in time for a patient with the skin form of anthrax, convalescence proceeds rather rapidly. On the second day after the beginning of treatment, sometimes somewhat later, the oedema decreases in size. Temperature drops to normal, and the patient begins to feel much better. In a few days the dead area of skin falls off, and the ulcerous sore which has formed is gradually covered by scar tissue. The patient remains in the hospital until the scar-forming process is completed. If the infected person did not go to a doctor immediately and treatment was begun late, the consequences can be fatal. This is explained by the fact that the microbes penetrate from the site of the skin infection into the blood and the internal organs, where they multiply in great numbers and cause anthracic sepsis. With this the condition of the patient becomes rapidly aggravated. Nothing can save him, since anthracic sepsis is incurable. After painful agony the patient dies. Death from the skin form of anthrax at present occurs only in extremely neglected cases, whereby the patient goes to a doctor after sepsis has developed. If treatment is begun in time, death does not occur.

The intestinal form of anthrax arises due to the human consumption of products from the meat of anthrax infected animals. At present these cases are extremely rare in

our country and as a rule are connected with the consumption of products of hand or domestic production (sausage, raw smoked meat), which have avoided health inspection. The production of sausage and smoked meat products at state and other centralized enterprises is under constant veterinary and medical supervision, a fact which guarantees their safety. In the past there were a few isolated cases of infection through milk from cows infected with anthrax. It is possible to become infected through dishes, spoons, knives and other domestic articles, which have not been sterilized by boiling after use in handling the meat of an anthrax infected animal. In the intestinal form of anthrax the carbuncle is formed in the wall of the intestine. The disease often begins with sharp pains in the stomach. Some patients experience a feeling of general poor health before this: chills, headache and an increasingly weakened condition. These are followed by nausea, vomiting, sometimes diarrhea with blood, and in certain cases -- constipation. The temperature increases to 39-40°C. The disease lasts three to four days, while sometimes the patient dies within 24 hours (particularly children); in other cases the disease lasts six days and more. As in the skin form, death occurs as a consequence of anthracic sepsis.

The pulmonary form of anthrax is rare at the present time. In the last century it was rather common, particularly among persons engaged in the collection and sorting of rags and those who breathed in much dust as a result of this. It was called the "rag picker's disease". The discovery of the anthrax microbe aided in establishing the true nature of this disease. After a brief latent period the patient begins to feel run-down and a constriction in the breast; he begins to experience coughing, chills and shortness of breath; his temperature rises to 39-40°C. The course of the disease is extremely serious. Anthracic sepsis almost always develops, and after a few days the patient dies. In all forms of anthrax the time the patient goes to the doctor is extremely significant for the consequences of the disease. The sooner the treatment of a patient begins, the greater are his chances for cure. Therefore, with any ailment occurring in a person who has come into contact with a sick person or a dead animal or with products obtained from an animal which subsequently died, it is essential to go to a doctor immediately.

Measures for Preventing the Disease In Humans

Humans can become infected with anthrax at home or on the job. Due to this, we distinguish production and

domestic infection. On the job persons come either in direct contact with animals (in stock raising) or deal with animal products which are being subjected to industrial processing. Therefore, production infections are broken down into agricultural and industrial. In respect to the rise and spread of infection, we distinguish the following three types of anthrax infection: agricultural (production), industrial (production) and domestic. In accordance with the various methods of infection, the measures taken for each type of infection also differ.

In cases of agricultural infection, affection occurs as a rule through direct contact with an anthrax infected animal while slaughtering it, removing the skin, handling the carcass and entrails. In the great majority of these cases the skin form of infection occurs, with affection on the hands and forearms. One or several carbuncles are formed on the sites of scratches and cuts received in handling the carcass. Sometimes persons are infected while gathering berries or while walking on meadows or in swamps. The areas where humans have become infected are sometimes quite a distance from a diseased herd but are within the flight limits of bloodsucking insects.

Cases of infection caused by the human consumption of the meat of anthrax infected animals are extremely rare since persons usually, learning of the appearance of anthrax on a farm, are very careful with animal products. Milk from sick cows and products made from it should not be used. They should be destroyed. During the period of quarantine milk is not hauled from the farm but is processed into butter. After the period of quarantine, the butter is boiled for two hours under the observation of a medical worker. The boiled butter obtained in this manner is released for consumption. Domestic objects which are used in slaughtering an animal and cutting up its carcass and intestines are disinfected or, if they are not valuable, are burned. In the quarters of infected persons, bed linen and objects which could have come into contact with discharges by the patient are disinfected.

Industrial anthrax infections. Infection occurs in processing industrial raw materials of animal origin: wool, hair, skins, bones, horns and hoofs. The ease in rendering these raw materials harmless is not identical in all cases. This is explained by the fact that, for example, hair (wool) does not contain blood vessels and therefore microbes do not penetrate them during the life of the animal. Hair is infected with anthrax spores only from the surface. Skin, bones, horns and hoofs contain blood and lymphatic vessels, into which bacilli penetrate in large numbers during anthracic sepsis, and these are transformed subsequently into

spores. As we have already mentioned, spores occur on the surface of wool and hair. This facilitates disinfection; excellent results are achieved by the application of such a simple method as paroformalene. In view of the fact that the spores penetrate deep into the skin, stronger methods of disinfection are required for destroying the spores in it, and these damage the raw material and are therefore inapplicable for industry. The technological process of the tanning industry included processing of skin (in the lye-washing unit), which kills the anthrax spores. But there is processing of non-disinfected raw material before it enters the lye-washing unit. Furs cannot be submitted to reliable disinfection. Therefore, in case of suspicion of infection by anthrax spores, it is necessary to burn the fur. Materials used for the production of bone meal -- bones, horns and hoofs -- should be disinfected by boiling or autoclave treating. In the wool processing industry, anthrax infections occur most often at enterprises engaged in the primary processing of wool, and chiefly in the dustiest shops -- the scutching and carding shops. Wool always contains much dirt which, during primary processing, settles in the form of dust in heavy layers on the walls of the shop, on the machinery, on clothing and the skin of workers, and collects under their nails. Anthrax spores may occur in this dust. Nevertheless, cases of anthrax among workers in the wool industry are extremely rare. This is explained by the fact that microbes do not penetrate through undamaged skin. Infection occurs basically during carding, when the spores come into contact with scratches together with dust on the surface of the skin or with dirt from under the nails. Machinery adjusters and cleaners pick up spores in scratches or small wounds inflicted in handling dusty machinery. Persons are infected much less often in transferring wool and on other jobs. Finished products (cloth and knit goods) present practically no danger in respect to anthrax infection, since the raw material is cleaned of all dirt, including spores, during industrial processing. Anti-anthrax measures carried out at wool processing enterprises consist primarily in the following. All workers are furnished with special clothing which is stored at the enterprise in lockers, apart from the personal clothing of the workers. The special clothing is changed regularly; it is laundered only after disinfection. Disinfection and laundering are conducted in an organized manner at the enterprise and at the cost of the enterprise. It is prohibited to take special clothing out of the enterprise. Another important element is the observance of bodily cleanliness. For this purpose the enterprise contains shower rooms where the workers wash themselves after work each day. It is necessary to see

that the workers maintain their nails cut short, since anthrax spores can collect under them together with dirt. The shops should be furnished with first aid supplies in order to be able to treat immediately accidental injuries to the skin. In the past four to five years at enterprises processing animal raw materials, workers have vaccinated against anthrax ("STI" Live Vaccine). But this does not make it unnecessary to use the above-mentioned general sanitary measures, the usefulness of which has been proved by years of practical experience. A planned and organized disinfection of all shops and machinery is done several times each year. If any worker has come down with anthrax, the enterprise is disinfected immediately.

Anthrax in the tanning industry. At tanneries workers are infected chiefly during sorting, transfer and other pre-production processes. In working with dry skins, considerably more infections occur than in working with skins which have been brine-treated. After the preliminary processing of skins (removal of hair and flesh) the danger of infection decreases. Skins which come from slaughter houses which are under veterinary supervision are not dangerous in respect to anthrax. Raw skins which come from areas unfavorable in respect to anthrax are specially checked at the plant (Ascoli reaction), and therefore finished products are rarely the cause for infection of humans. Affection occurs through scratches received in transferring skins or in scratching the skin with dirty nails. The skin form of the disease occurs most often. Measures in preventing infection among the workers are the same as those used in the wool-processing industry: special clothing, separate storage of special clothing and personal clothing, disinfection and laundering of special clothing at the enterprise, prohibition against removing it from the enterprise. Shower facilities are provided for workers. Vaccinations are given against anthrax. Production waste material (wool, flesh, etc.) is burned in special furnaces provided at the plant.

Domestic anthrax infections. As has been mentioned, anthrax infection of persons in the home can occur with direct contact with a diseased animal (slaughtering, cutting up the carcass, skinning). Cases of infection have occurred during the preparation of food from the meat of anthrax infected animals. In cutting up the meat the anthrax spores come into contact with domestic implements: tables, wooden boards, etc. If these objects are not subsequently rendered harmless they can cause infection among humans. We shall cite one case as an example. A woman was cutting up mutton on a kitchen table. As was later ascertained, the sheep was infected with anthrax. After a short time the daughter of this woman leaned on the table with her bare elbows. A

few days later she came down with anthrax, and carbuncles appeared on both elbows. This case demonstrates the danger caused by household objects which have not been disinfected due to negligence on the part of their owners. Products of animal origin (wool, skins, hair, etc.) can serve as a source of infection of humans in the home as well as on the job. However, in the home infection is caused more often by handmade or homemade articles from products of animal origin. Sometimes infection is caused by wearing fur articles -- collars, hats, gloves or mittens, made from the fur of anthrax-infected animals. The most dangerous are old and worn fur articles (since the spores are not in the fur itself but the skin). In these cases the carbuncles form on those areas of skin where the worn fur lies up against it and has caused it to be worn. Upon infection from a collar (sheep, goat) the carbuncle appears on the face or neck; on the forehead -- upon infection from a cap; on the skin of the wrist -- from fur from a sleeve; on the fingers and hands -- from gloves and mittens. Kerchiefs, caps and other hand or homemade woolen articles are sometimes a source of infection. Homemade or handmade shaving brushes, if they are manufactured of infected hair, can cause carbuncles on the face, chin, throat, and toothbrushes -- in the mouth. The above household infections should not lead to the conclusion that any person wearing fur or wool articles is constantly threatened by infection. Such cases are extremely rare. But everyone should remember that upon the appearance on the skin of a thick knot on the site of an abrasion or scratch one should see a doctor immediately. Infections of food origin occupy a special place among household anthrax infections. The infection occurs due to undercooked meat or hand and homemade articles prepared from it (sausage, etc.), as well as raw smoked and dried foods. It follows that the meat from animals slaughtered through necessity must be well boiled or roasted and that it should not be consumed in a smoked form. Various measures are taken upon the appearance of anthrax infection of a household nature in order to prevent the spread of this infection. The measures depend on the source of infection. If the infection occurred during contact with the body of a slaughtered or dead anthrax infected animal, the same measures are carried out as during livestock epidemics. Objects through which the infection has occurred or which are suspect are subjected to reliable disinfection (if possible) or burned. Fur and skin articles cannot be rendered harmless and must be burned. It is also recommended to burn articles which are of no great value. In the quarters of a patient, after he has been taken to the hospital, his bed linen and underwear are disinfected, as well as the things in his personal

use. Persons having come in contact with the patient are kept under medical observation for ten days. In rural areas the most common source of infection is an animal which has had to be slaughtered. In these cases it is necessary to find all parts of the animal and all objects having come into contact with them. These should all be burned. That which cannot be destroyed (for example, soil) should be well disinfected.

How Anthrax Runs Its Course In Animals

Anthrax attacks not only domestic stock -- cattle, sheep and goats, horses, donkeys, mules, camels, reindeer and hogs -- but certain wild herbivorous animals -- elk, reindeer. Predatory animals are seldom infected, only in case their organism has come into contact with a tremendous quantity of microbes upon eating the meat of anthrax infected animals. Birds are not affected by anthrax. The latent period of the disease lasts one to three days in animals, seldom as long as eight days. Depending on the path of infection, the disease is manifested in the intestinal or skin form. The basic symptoms of the disease are the following. Body temperature rises sharply. The animal becomes sluggish, breathing becomes difficult, convulsions ensue, the mucous membranes of the mouth, nose and eyes are of a dark red color with a bluish tint. The stomach becomes distended. The urine and dung are mixed with blood. Swelling occurs on various spots on the body. Quite often a blood-containing liquid is discharged from the anus and nostrils before death. The following forms of anthrax are distinguished according to gravity of the disease. The lightning form, with which death occurs suddenly a few hours after the symptoms appear, particularly among sheep. The acute form lasts one to two days, and the sub-acute -- two to five days. A chronic form of anthrax is also known to occur, most often among hogs. The disease is manifested in the form of tonsillitis with strong ~~oedema~~ of the larynx. Breathing is difficult and the animal dies from strangulation. The mildest form of anthrax in animals -- carbuncle -- occurs upon infection due to the sting of blood-sucking insects; the sickness lasts for five to seven days and the animal may get well even without treatment. This form occurs most often in horses.

The corpse of an animal stricken with anthrax is swollen up. Stiffening does not occur or is manifested faintly. A foamy-blood-containing liquid flows from the anal passage and nostrils, and sometimes dark blood. Jelly-like blood-filled swollen spots of a yellowish color occur

under the skin. The same jelly-like mass is found in hogs under the skin in the submaxillary region, in the region of the larynx and on the neck. Numerous hemorrhages are visible in the form of spots of varying sizes under the skin and on the surface of the peritoneum, the intestines, lungs, liver, spleen and other organs. Blood vessels are filled with dark uncoagulated blood, the heart and all the muscles are flabby and of a dark red color. The spleen is distended and flabby. A blood-containing liquid is found in the thoracic and abdominal cavities. One must keep in mind that in case of slaughter by necessity all these changes in the internal organs may not be yet well developed, particularly if the animal is slaughtered in the beginning stages of the disease.

How Animals are Infected with Anthrax

A source of infection are animals already infected with anthrax, but healthy animals are not infected directly by them. Diseased animals discharge anthrax bacilli with their saliva, urine and excrement, contaminating in this manner pastures, water-holes and all places where these animals have been, as well as objects with which they have come into contact. By means of contaminated grass, hay, other feed and water, infection of healthy animals occurs. Anthrax bacilli and spores can penetrate through the mucus membrane of the mouth, particularly the pharynx, and get into the blood, with which they are carried into the internal organs. Infection of animals through the skin is caused most often by blood-sucking insect bites, who have already stung anthrax-infected animals or who have come into contact with their excrement. When, after the appearance of the first cases of infection connected with grazing on contaminated pastures, the infection is spread by flying insects, a mass dying off of stock begins. Soil plays an important part in maintaining anthrax infection in nature, since the spores are preserved for decades in it. Contaminated sections of soil, that is, old livestock graveyards, single graves, ravines and other localities where corpses of anthrax diseased animals were buried or thrown, are constant centers of anthrax contagion. These include places where mass losses of cattle have occurred or livestock slaughter, the territory of former primitive tanneries and other enterprises for the processing of animal raw materials (hair, wool, horns, hoofs, bones, etc.). In all these localities small bodies of water (ponds, small lakes, streams, etc.) are usually contaminated by anthrax spores. Livestock can become infected with anthrax when grazing and

watering in these localities. If the soil and small bodies of water are contaminated, during spring floods and heavy rains the spores can be carried by the water over great distances. Carried to flood-meadows, pastures and livestock grazing lands, the spores contaminate them, and cases of anthrax occur in localities where there had been none previously. The spores are transformed into bacilli on the surface of soil containing nutrients (humus), with sufficient moisture and suitable temperature (15-20 degrees). The multiplied bacilli once again are transformed into spores, and the soil becomes even more contaminated. If this occurs on moist flood-meadows, infection among animals will be spread through the hay harvested on these meadows.

Measures for Preventing Infection of Livestock

In order to prevent the infection of livestock with anthrax, general veterinary-sanitary measures are conducted. We shall mention the basic ones. Each settlement, kolkhoz and sovkhos should have an animal burial ground. It should be layed out on a dry, elevated area, at a distance of no closer than 1 kilometer from houses, structures for housing livestock, industrial enterprises, apiaries, rivers, ponds, wells, springs and other reservoirs. In order that animals have no access to the animal burial ground, it should be surrounded on all sides with a fence or wall 2 meters high, and on the inside a ditch should be dug 1½ meters deep. The ditch is designed to hold rain and melted snow runoff from the soil of the animal burial ground. A gate with a lock is included for entering the animal burial ground, and a small bridge is built across the ditch.

With the first cases of anthrax infection of animals, it is important to diagnose the disease as quickly as possible and immediately carry out anti-epizootic measures. Diseased animals should be isolated. The healthy stock is driven to another pasture or, if the epizootic has occurred during the period of being kept inside, they are transferred to other structures. A quarantine is place on the stricken farm and veterinary supervision is maintained to enforce the quarantine. During the period of quarantine it is prohibited to bring animals to the farm or take them away, as well as to use animals for driving to the farm and away from it. During the same period it is prohibited to slaughter livestock on the farm and to haul away from it meat and milk products. In the heart of the epidemic area, the animals are first given quick-acting serum, but for a short period of time, and they are subsequently vaccinated, as a result of which they become immune to infection. Only

vaccination is carried out on threatened farms where there have been no cases as yet. The destruction of the carcass of an anthrax diseased animal is of considerable prophylactic significance, since it presents great danger for humans and animals. The best method of destroying a carcass is to burn it together with the hide on the spot where the animal has died or been killed, if this does not violate fire prevention rules. Otherwise the carcass should be burned at the animal burial ground. The process of cremation should continue until the carcass is fully calcinated.

In transporting the carcass to the animal burial ground it is necessary to take all measures to prevent a spreading of the contagion. Therefore, it is necessary to make use of means of transport with a metal body (for example, a dump truck) or lined with iron on the inside, that is, that which can be reliably disinfected. Before loading, the carcass is literally sprinkled with odorous solutions (creoline, creosote, carbolic acid) in order to drive away insects. In order to prevent liquids containing anthrax microbes, flowing from the natural orifices of the carcass from falling on the ground and other objects, the anus and nostrils are plugged up with tow. The head should be wrapped in an old sack, generously soaked in the above-mentioned disinfectant solutions. In the absence of a special box for the carcass, it is recommended to cover it completely with old burlap. In exceptional cases, when it is not possible to burn the carcasses, it is permissible to bury them at the animal burial ground. With this method the spores are not destroyed and long preserve their viability in the soil. The carcasses of animals should be buried at least 2 meters deep. Chloride of lime should be spread on the bottom of the hole, after which the carcass is dropped in, and then an upper layer of dirt upon which it lay, and once again they shovel chloride of lime over the body and the dirt. Above the grave they make a mound of at least $\frac{1}{2}$ meter in height. All of this occurs under the direct supervision of a veterinary worker. In areas where anthrax infected animals had been kept, the place is disinfected with a 20% solution of chloride of lime, (containing at least 25% active chlorine), 10% hot solution of caustic soda or sulphur-carbolic mixture. The disinfectant solution is applied in the amount of 1 liter per square meter of area for each treatment. Disinfection is carried out three times at 1 hour intervals. Contaminated manure, litter straw and feed are burned.

2. Methodological Instructions

The lecture content should be changed depending on the composition of the audience; taking this into consideration, the lecturer should make a suitable selection from among the material furnished by us. Basic symptoms of the disease, properties of the pathogene, means of infection, measures for preventing it and the significance of early treatment are essential for any audience

It is recommended to conduct the lecture in the form of examples of cases of anthrax in the given localities or other actual cases. It is useful to cite examples of infection caused by contact with anthrax infected animals (slaughter of animals, cutting up of their carcasses, skinning); to demonstrate the significance of seeing a doctor immediately and after delay; to note the danger of consuming the meat of anthrax infected animals. It is also necessary to warn the audience that it is dangerous to purchase from private individuals at markets or on the road sausage, smoked meats and other meat products, since they can cause an infection of the intestinal form of anthrax. In rural areas the lecturer should draw the particular attention of the audience to the danger of the forced slaughter of domestic animals without the permission of the office of veterinary supervision, stressing the impermissibility of contaminating the soil and reservoirs with the blood, excrement and water used for washing off force-slaughtered animals. It is necessary to elucidate in detail the significance of the extended preservation of anthrax spores in the soil and in water, to indicate the significance of maintaining the barnyard and stalls in a sanitary condition, as well as the rules for maintaining the animal burial ground.

In giving a lecture at an enterprise, the lecturer should take into consideration the specific features of this enterprise. It is essential to note the role of general sanitary measures (combating dust, organized disinfection, laundering, disinfection and storage of special clothing and special shoes) and measures of personal prophylaxis (separate places for keeping special clothing and personal clothing, obligatory shower after work, trimming nails, inspection of arms for cuts and scratches, treatment of the latter). If the lecture is for technical and administrative personnel, the lecturer should devote particular attention toward rendering raw materials harmless (wool, hair), the ascertainment of contaminated hides, the destruction of production waste materials and the prevention of

soil and reservoir contamination by means of waste materials and sewage containing anthrax spores. It is also important to thoroughly explain the significance of measures for protecting workers from infection at the plant; the provision of shower facilities, lockers for the separate storage of special clothing and personal clothing, the organization at the plant of the disinfection and laundering of special clothing and the provision of a first-aid case for each shop.

3. Model Lecture Plan

For a Mixed Audience

1. Introduction (the spread of anthrax in ancient times, in pre-revolutionary Russia and in the USSR; the significance of the state's system of anti-anthrax measures in decreasing the incidence of anthrax).

2. The anthrax pathogene and its properties (vegetative and spore forms of bacteria; their stability toward disinfectant substances and high temperature; extended preservation of the spores in the soil and in water and the significance of this in epidemiology and epizootology of anthrax). Reliable methods of rendering harmless objects contaminated with anthrax spores.

3. Mechanism for infecting humans (through injury to the skin, bites by blood-sucking insects, alimentary). Infections in the home and measures of personal prophylaxis.

4. Anthrax in humans (short description of clinic with the skin, intestinal, and pulmonary forms of the disease). Significance of seeing a doctor immediately and timely treatment for the outcome of the case.

For Agricultural Workers

1. Introduction.

2. The pathogene and its properties.

3. Types of domestic animals spontaneously infected with anthrax.

4. Mechanism of infection of domestic animals.

5. Clinical manifestations of the disease in animals.

6. Clinic of the various forms of anthrax in humans (brief summary). Significance of seeing a doctor immediately.

7. Forced slaughter of sick animals and its significance in infecting humans. Measures of personal prophylaxis in the forced slaughter of livestock.

8. Anti-anthrax measures in rural areas (vaccination of livestock, veterinary-sanitary measures for preventing the disease and with the occurrence of the disease in domestic animals).

At An Industrial Enterprise

1. Introduction

2. The pathogene and its properties.

3. Mechanism of infection. The predominant clinical form of anthrax in the given branch of industry (wool-processing, fur, tanning).

4. Types of animal raw materials which can be contaminated with anthrax spores.

5. Preventative measures at the enterprise (anti-dust campaign, prophylactic planned disinfection of the premises and machinery, storage and disinfection of special clothing, shower facilities, first aid kits for the shops).

6. Measures for preventing contaminated raw materials from coming to the plant (disinfection of suspicious wool and hair).

7. Personal prophylaxis measures on the job (correct storage of special clothing, use of the shower, cutting finger-nails; immediate treatment of the smallest skin abrasions and cuts. The danger of scratching the skin with dirty hands. Significance of seeing a doctor immediately upon becoming infected.)

4. Appendix

Combatting Anthrax

A decisive role in the fight against anthrax was played by the discovery of the pathogene of this infection and a study of its properties. In the middle of the last century (1849-1850) Daven [transliteration from Russian] and Meier in France and Pollender in Germany discovered in the blood of animals which had died from anthrax large bacilli, the length of which was double the diameter of an erythrocyte. Somewhat later, working independently of the above-mentioned scientists, Brouyel' (Russia) observed these microbes in the blood of animals with anthrax, not long before their death. Daven also established that the disease is transmitted only by the blood, which contains the bacilli.

Further success in the study of the properties of anthrax bacilli was based on the works of R. Koch, who separated it into a pure culture and demonstrated in experiments on animals its etiological significance. Later it was established that anthrax bacilli form spores which are distinguished by a high degree of stability under various harmful influences; they can maintain their viability for years in an external environment, particularly in soil.

Having the opportunity to work with pure cultures of anthrax bacilli, researchers directed their efforts at seeking a method of weakening the virulence of the cultures with the aim of obtaining a vaccine against anthrax. Pasteur (1880) noted in breeding anthrax cultures under raised temperature conditions (42.5° C) that their virulence decreased in the degree that the animals infected by them remained alive and became resistant to infection by freshly-introduced anthrax cultures. These results obtained in experiments were verified by Pasteur on domestic animals. In 1881, on the farm Puyi-le-For [Russian transliteration] he immunized by means of vaccine 25 sheep and six head of cattle. Two weeks after vaccination all immunized animals and an identical number of test animals were infected with a virulent anthrax culture. All immunized animals survived, while all test animals died from anthrax. Pasteur's vaccine received wide use at first in France and later in other countries. In Russia Tsenkovskiy developed a vaccine on Pasteur's principle, and this vaccine is still used. As early as the last century science equipped practice not only with methods for the diagnosis of anthrax but reliable prophylactic vaccine

for protecting livestock from this infection. In subsequent years improvements were introduced in the manufacture of the prophylactic preparation. During the Soviet period this preparation was improved by Ginzburg (1940), whose vaccine ("STI") produces a reliable effect upon single injection, while Pasteur's and Tsenkovskiy's vaccine requires two injections. Vaccination of domestic animals sharply decreased the incidence of anthrax, as well as that among humans. Reports and literature on the subject show that anthrax occurs throughout the world. It is particularly wide-spread in countries with well-developed animal husbandry. The frequency and intensity of epidemics depend on the anti-anthrax measures taken. Such measures are insufficient in the countries of the Near East (Afghanistan, Iraq, Iran, etc.), and these countries have a high incidence of anthrax. In the industrial processing of animal raw materials from these countries, this circumstance must be taken into consideration and particularly strict observance must be maintained in measures for the prophylaxis of anthrax.

Pathological Anatomy

In an external examination of the bodies of humans and animals who have died from anthrax, the absence of rigor mortis is often observed, which is caused by rapid decay of the tissue. The following changes are found in the internal organs: the spleen is distended, filled with blood of a dark-red color, and produces abundant scrapings; the liver is plethoric, sometimes distended, and in some cases hemorrhages appear on the surface. The muscles of the heart are usually flaccid. Hemorrhaging often occurs in the myocard and the epicard. Warty growths may form on the valves. Blood in the cardiac cavity is fluid and non-coagulated (lacquer, like tar). The cardiac pouch contains serous or serous-plethoric exudation. In the lungs -- bronchial pneumonic nidi with serous-fibrinous and hemorrhage saturation of the tissue. Drying and oedema of the lungs is observed as well as hemorrhaging and mucous necrosis. Sometimes the affection nidi have the nature of infarcts. The cellular tissue is pleurose, and in the mediastenum is oedematic and jelly-like. The peratracheal and bronchial lymphatic knots are greatly distended, filled with liquid, soft in consistency, permeated by hemorrhaging, due to which they are of a dark-red and sometimes even of a black color. Their tissue has undergone great changes, is penetrated by leucocytes and a large number of bacilli. Carbuncles of various sizes, as much as several cm in diameter, may form in the intestine. Their consistency is soft, often jelly-like. The

color of the carbuncle changes -- depending on the period of development -- from yellowish-gray to yellow-brownish and even red. The surface of the carbuncle is covered by a scab, which becomes softened at a later period, as a result of which an ulcer forms which is surrounded by an extensive oedema. Sometimes the affection is expressed only by diffuse hemorrhage infiltration with surrounding oedema without the development of a carbuncle. In secondary affections, arising hematogenically, small hemorrhages form without oedemae around them. A large number of serous-blood exudations occur in the abdominal cavity.

Characteristic pathological-anatomical changes develop in the brain and its coverings with anthracic sepsis. The hard brain covering is under tension, plethoric, the sinuses are stretched and filled with thick, dark blood. The soft brain covering is thickened and dark red in color; its vessels are expanded and plethoric, due to which an impression of a cap consisting of blood clots is created, which cover the brain ("Hippocrates' cap"). The brain tissue is flaccid, plethoric, of a characteristic raspberry color and contains many hemorrhages.

The most expressed affections develop in those organs in which occurred the introduction of anthrax bacilli and their primary propagation. In the skin form, in place of the introduction of the pathogene, at first a pustule appears with hemorrhagic contents, and then a carbuncle develops with hemorrhagic inflammation infiltration. Most of the carbuncle is a well-defined swelling of a solid and less often doughy consistency. A scab forms in the center of the carbuncle due to dried-up epidermis, oozing lymph and the Malpighian layer. The skin under it is necrotic for a certain depth, and the subcutaneous cellular tissue is saturated with a jelly-like, serous or fibrinose exudation. The regional lymphatic glands are distended, of a soft consistency and often are of a dark red color as a result of hemorrhagic infiltration. Anthrax bacilli are contained in large quantities in the pustule, in the oedematic fluid and in the lymphatic vessels. They are not to be seen on the surface of the dead section, but various foreign flora occurs. Inside the surface layer of the scab the bacilli occur in small numbers, mostly in degenerated forms. In the deeper layers they are of the typical form, but often they form long chains. In the intestinal form of anthrax the affections are localized mostly in the lower section of the small intestine, near the bauginian protective covering and in the caecum. They occur more often singly, but they also occur in numbers of 20 to 30 and more, of varying sizes. In structure the affection nidi are analogous to the skin carbuncle. They can be seen clear-

ly through the peritoneum and are noticeable on the outer surface of the intestine in the form of red spots. The mesentary, the epiploon, the mesentary-lymphatic knots and the transabdominal cellular tissue are saturated with blood.

In cases of pulmonary anthrax (primary) a careful examination of the body usually results in the discovery of the entrance of the infection in the form of a hemorrhagic-necrotic nidus in the nose, in the upper respiratory tracts or in the large bronchi. The affected lung contains a more or less large number of pneumonic nidi, which may occupy a considerable portion of the organ. In various sections of the lungs infarcts containing blood and gangrenose nidi occur. Serous-jelly-like infiltration occurs in the interstitial tissue. In the alveoli of the affected sectors of the lungs, serous exudation is found, and in the pleural cavity -- serous or serous-hemorrhagic exudation. The primary pulmonary form as a rule ends with anthracic sepsis.

Hystological changes. The vascular system suffers to a particular high degree with anthrax -- the capillaries, precapillaries, arteries, veins and lymphatic vessels are affected. Sometimes larger vessels are also affected. Primary and secondary affections differ from one another. In the primary affection the process in the vessels develops chiefly from the exterior to the interior; necrosis spreads from the adventition toward the intima. Vessels can be found in which the middle and exterior layers are necroticized, and the inner layer is stretched out in the form of a unique aneurisma. Ruptures of the intima may occur during such vascular changes. In secondary affections, occurring hematogenically, the vessels are expanded, filled with blood, and stasis can be observed. The inner layer is often necroticized with undamaged or little changed middle and external layers. The vascular endothelium swells, increases in size and cracks. Often vessels occur with a defect in the wall as a result of necrosis of all its layers, due to which blood form elements penetrate from the vessel into the surrounding tissue.

Pathogenesis

The significance of injuries to integuments in the occurrence of anthrax infection was clearly demonstrated by Derizhanov in his experiments on rabbits. After preliminary damage to the mucous membrane in the lower region of the small intestine (a needle scratch) Derizhanov introduced a suspension of anthrax bacilli with a hypodermic injection in the aperture of the small intestine in its upper region. A typical anthrax carbuncle developed on the site of the

damaged mucous membrane of the intestine of the animal, while on the the site of the introduction of the culture (in the upper region of the intestine) there were no pathological changes except for a vestige of the needle prick. Derizhanov obtained analogous results in experiments in introducing anthrax cultures into the stomach, in which the mucous membrane had been preliminarily injured.

As a result of his observations, Derizhanov arrived at the conclusion that the process of inflammation in the intestine which preceeds infection furthers the introduction of the anthrax microbe. This is explained by the fact that during inflammation the safety of the epithelium of the mucous membrane of the intestine is violated and the anthrax bacilli penetrate into the sub-mucous layer. In the sub-mucous layer the bacilli are protected against the action of the intestinal juices and competing intestinal microbes, and due to the abundance of blood and lymphatic vessels they are assured of nutrients. With these favorable conditions, the anthrax bacilli multiply even more rapidly in the sub-mucous layer. The epicellular fluid is a favorable environment for them. Two to four hours after infection the vegetative forms which have formed from the spores are already multiplying. In animals which have not been immunized and are susceptible to anthrax, the propagation of bacilli continues, and by the end of the life of the animal their number reaches a total of hundreds of millions per ml of blood or gram of tissue. In immunized or naturally resistant animals, two to four hours after infection the bacilli begin to die and disappear from the nidus of the affection.

For the development of the anthrax infection process, of great significance are factors which influence the capsule forming of the microbe. In progressing affections the majority of bacilli remain incapsuled. When resistant animals are infected, the capsules disappear before the beginning of degeneration and disintegration of the microbes. The pathogenic action of anthrax bacilli, as is apparent from the description of pathological-anatomical changes, is manifested morphologically chiefly in necrotic changes in the membranes of the blood and lymphatic vessels, which cause much hemorrhaging. Antigenous matter and the products of the vital activities of the anthrax bacilli do not have a toxic effect on normal white mice and guinea pigs. During the course of the infection process they sensitize the organism of the animal or the human patient, and at the termination of the process, gathering in the blood and organs in extremely great numbers, these substances cause a violent reaction of an anaphylactic nature,

terminating in the destruction of the organism.

Immunity

An organism which has recovered from anthrax develops an immunity, but this does not last the life of the organism. This is testified to by repeated affections occurring among veterinary workers.

Diagnosis

Diagnosis of the skin form of anthrax in the majority of cases presents no difficulties due to the presence of the characteristic anthrax carbuncle and surrounding oedema. In some cases a similarity to furunculosis can be noted, erysipelas, glanders, but all these affections are painful, while the anthrax carbuncle is not, and with the presence of an oedema, the skin surrounding them is hyperaemic and hot to the touch.

Diagnosis of the visceral forms (intestinal and pulmonary) of anthrax is much more complicated, whereby local changes develop in the internal organs, and the general manifestations of the disease do not have characteristic features. An epidemiological analysis, which affords great aid in diagnosing the skin form, with visceral anthrax often causes no suspicion as to the nature of the disease. Suspicion on the part of the physician as to the visceral form of anthrax is of great significance, since it leads to a quick application of specific therapy, which may save the life of the patient. Suspicion of anthrax should be caused by the suddenness of the patient's coming down with the ailment and discrepancy in the seriousness of the complaints on the part of the patient (sharp pains in the stomach, general run-down condition or constriction in the chest, difficulty in breathing) with the objective data obtained by the physician during examination. In doubtful cases of the skin form and with suspicion of the visceral form, the question of the nature of the ailment is answered with the aid of specific diagnosis based on the discovery of the anthrax pathogene in the organism of the patient.

The anthrax microbe is diagnosed by several characteristic indications, of which we shall name the most important. The microbe is in the form of a large bacillus, reaching the length of 5-8-10 μ in length and one μ in length. The bacilli are interconnected in chains which differ in length, depending on the conditions of the environment in which they are found. In ordinary artificial nutrient media

the anthrax microbe grows in the shape of long chains consisting of large capsulless bacilli, which do not differ in their morphology from large non-pathogenic bacilli from the anthracoid group. In the organism of an animal or human, the bacillus forms a capsule, a protective device against injurious action by the organism of the bearer; it is a case of mucous matter surrounding the body of the microbe. Capsule microbes also unite into chains, but they are short and consist only of a few bacilli. These bacilli differ in their morphology from non-pathogenic bacilli: their ends are thickened and as if cut off, reminding one of sticks of bamboo. In an artificial nutrient medium or an external environment, with the presence of suitable conditions, anthrax bacilli are transformed into the spore form. The spore is a strong light-refracting oval shape situated in the center of a cell. Its diameter does not exceed the width of a bacillus. Only one spore forms from each bacillial cell. The presence of oxygen, nutrients, moisture and temperature within limits of 15-42.5° C (optimum temperature -- 32-35° C) is essential for spore formation. At a temperature of 12° C propagation of bacilli and formation of spores cease. If conditions correspond to the above, the vegetative forms are transformed into spores in a comparatively short period of time: from 12 hours to several days. In the absence of these conditions the bacilli do not become transformed into spores and perish. If the body of a human or animal is not dissected, the spores do not form and the bacilli die (dissolve) as a result of lack of oxygen. In the summer this takes place within one to three days.

The resistance of the anthrax microbe to injurious external influences varies, depending on the form in which it occurs. The vegetative form approximates in its resistance the pathogenic microbes of the intestinal group: it easily submits to the action of ordinary disinfectant solutions (phenol, lysol, etc.) and dies at a temperature of 60-70° C. As opposed to the vegetative form, the anthrax spore is extremely resistant to external influences. Ordinary disinfectant solutions (corrosive sublimate, carbolic acid, lysol) are not used, since they have little effect on anthrax spores. A 10-20% solution of chloride of lime, a 5-7% solution of chloramine and a 10-20% hot solution of caustic soda are considered effective. These are used widely in anthrax foci. Boiling kills spores in a water suspension in 10-20 minutes. However, it is necessary to keep in mind that in practice anthrax spores are not found in water suspension but in albuminous substances (the flesh, blood and excrement of a diseased animal), which protect them from thermal action and increase their resistance.

Practice has shown that in the presence of albuminous substances two hours of boiling is effective in decontaminating objects contaminated by spores. The resistance of spores to their external environment is extremely high. In water they can maintain their viability for years, and in soil -- for decades. The microbe is unpretentious in respect to nutrient media. It flourishes in weakly alkaline agar and in weakly alkaline broth under aerobic conditions at 15-35° C. Anthrax bacilli can grow in hay infusions, pea stalks, on extracts of cereal and bean seed.

According to cultural and morphological properties of the anthrax microbe, even in a pure culture it is impossible to distinguish it with complete security from similar large non-pathogenic bacilli from the anthracoid group. A determination of its pathogenicity serves as a reliable criterion in diagnosing the anthrax microbe. In laboratories carrying out research on anthrax they do not limit themselves to a study of the morphology and nature of growth of the culture in nutrient media, but they always infect lab animals (mice or guinea pigs). The characteristic pathological-anatomical picture in dissecting an animal which has died, the discovery in its blood and internal organs (spleen) of capsule anthrax bacilli, as well as the discovery of their antigenicity by precipitation reaction (Ascoli reaction) prove the anthracic nature of the culture under observation.

In the skin form of anthrax the contents of the pustule are examined. In smears prepared from it an extremely small number of form elements are revealed: single leucocytes can be seen. This phenomenon is caused by the negative chemotaxis of the anthrax bacilli. It should warn the physician of the possible presence of anthrax. In examining the smears short chains are easily revealed, consisting of two to four thick capsule bacilli, possessing thickened ends which appear to be cut-off. In structure the chains remind one of a stick of bamboo. The bacilli are characteristic in appearance and easily distinguishable from other bacteria. In coloring according to Romanovskiy-Gimza the capsule, in the form of a pink casing, surrounds a dark blue bacillus. On the basis of this picture it is possible to diagnose anthrax with full assurance. In these cases bacteriological study and infection of animals are not essential.

If the picture is not clear, for example, if it is not possible to find streptobacilli, but at the same time the contents of the pustule are poor in form elements, it is essential to send the material to the lab. However, without awaiting the results of the analysis, treatment should be given to the patient in accordance with the clinical manifestations of the disease. Upon suspicion of an-

thrax it is important to remember the serious nature of the disease and the danger of delay in applying specific therapy.

In the subsequent stages of the development of the disease, when the scab has formed or a necrotic section has already formed on the site of the former pustule, bacteriological study is useless, since there are no anthrax bacilli on the surface of the scab. Within the necrotic section, particularly in its deeper layers, anthrax bacilli do occur; however, it is impermissible to extract them. Injury to the scab or the necrotic section of skin may cause the development of anthracic sepsis, which would inevitably lead to the death of the patient. We should mention that in the period of the disease when the scab or necrotic section form, the clinical picture is so clear that lab study is not required for diagnosis.

Early diagnosis of the visceral form of anthrax is more complicated. In cases of suspicion of the intestinal form it is necessary to keep in mind that anthrax bacilli are discharged from the affected section of the intestine in large numbers with blood masses. It is therefore essential to make a careful examination of excrement in order to discover in it blood admixtures, the bacterioscopic study of which will make it possible to establish the nature of the ailment. The presence of capsule bacilli joined in short chains, confirming a diagnosis of anthrax, indicates the necessity of beginning suitable treatment immediately.

In the pulmonary form secretion of blood clots is observed in coughing, and these clots contain a large number of anthrax bacilli. An early diagnosis of the ailment is also possible in this form, if a careful examination is made of the patient's phlegm for the presence of blood containing admixtures. In the absence of blood admixtures in the excrement or phlegm, these materials should be sent to the lab in suspicious cases. Simultaneously it is necessary to begin suitable treatment, taking into consideration that the visceral form of anthrax runs its course more rapidly than the skin form, and leads to the death of the patient as a rule in the absence of specific treatment.

A pathological-anatomical diagnosis of anthrax is of great practical significance in cases whereby while the patient was still alive it was impossible to establish the anthracic nature of his ailment and prophylactic measures had not been taken to prevent the spread of infection. Therefore, upon dissecting bodies of persons dying from a vague diagnosis, one should make a careful examination of the internal organs and cavities in order not to overlook morphological changes which are suspicious in respect to anthrax.

Not all persons dying from anthrax have the full scope of the above-depicted pathological-anatomical changes. Sometimes the changes are limited to small hemorrhaging, the presence of an enlarged, soft lymphatic knot of a dark color and hemorrhagic exudation in the abdominal or pleural cavities. With a microscopic study of smears from such sublayers it is easy to discover the characteristic chains of capsule anthrax bacilli. In outbreaks of the visceral form of anthrax the first cases are usually diagnosed after the death of the patients, upon dissection, which consequently plays an extremely important part in ascertaining the source of infection in the nidus.

Treatment

The best therapeutic method for anthrax is specific anti-anthrax serum. It is obtained from horses which have been hyperimmunized by a living virulent anthrax culture. The effectiveness of this serum is caused by the presence in it of protective so-called "antracocidal substances". Their mechanism of action consists in the following: they destroy the anthrax bacilli capsules, the latter are swallowed up by phagocytes and are destroyed in this manner. This is the defense mechanism of immunized animals against anthrax. The serum is introduced to the patient intramuscularly, and in grave cases can be introduced intravenously. In the absence of "medicinal" serum it is possible to obtain serum for animals from veterinary physicians. This serum is just as effective as the medicinal, but it is less pure of ballast substances. It should not be shaken before use and cannot be introduced intravenously (only subcutaneously or intramuscularly).

It is recommended to introduce the serum according to Bezredka. 100-150 ml are introduced in the first injection. If there is no improvement (drop in temperature, decrease in swelling, improvement of general condition) the serum is introduced a second time in 8-10 hours and then on the following day. The total amount of serum introduced can reach several hundred ml, depending on the gravity of the particular case. There is no danger of introducing too much serum. The patient is under no danger of anaphylactic shock, since serum treatment lasts several days, during the course of which sensibilization will not reach a high degree. The use of serum can cause serum sickness, but it passes and presents no danger to the patient.

Neosalvarsan and antibiotics (penicillin, streptomycin) are used as auxiliary remedies in serum treatment.

With a localized process serum therapy produces fine results. When the process takes on a generalized nature and anthracic sepsis ensues, treatment is ineffective. Therefore, upon suspicion of anthrax, particularly if there are reasons to believe that it is the visceral form of the disease, it is essential to proceed with the introduction of serum as rapidly as possible.