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Anthrax in Swine

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ANTHRAX IN SWINE

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Anthrax is not commonly considered so important a menace to swine as it is to other forms of farm live stock, in which the disease is apt to declare itself with terrifying severity. In comparison with the marked mortality frequently observed in cattle, the tangible losses caused by anthrax in swine seem negligible. As recent as 25 years ago, there still were observers who sincerely doubted the occurrence of the disease in hogs and this opinion found some support in the many reported failures to induce the infection in that animal species by artificial methods.

That these views and opinions were erroneous can no longer be doubted. In all probability they were largely based on a lack of understanding of anthrax as it occurs in swine. The well-known characteristic features of the disease in cattle, in which the acute and peracute septicemic form of the malady predominates, was quite naturally expected to be displayed also by infected swine, whereas in this animal, with few exceptions, anthrax is likely to be of a more benign nature, tending toward chronicity and often without being accompanied by any objective symptoms at all.

As a result of the investigations of Dammann and Freese,[1] Elsässer and Siebel,[2] Elsässer,[3] Glage,[4] Nieberle,[8] and Zwick,[9] the nature of swine anthrax has become better understood. They showed conclusively that in Germany, at least, the disease is by no means uncommon and that its characteristic features must be attributed to the fact that the susceptibility to anthrax on the part of this species is far less marked than the one displayed by other farm animals. This apparent resistance dominates the

patho-anatomic as well as the clinical manifestations presented by swine, when actually involved in the disorder.

The epizoötiologic backgrounds of swine anthrax in this country differ somewhat from those prevailing in Germany, but the fact remains that especially in our own anthrax areas, the disease in swine is by no means uncommon. In its more conspicuous form we see it or hear about it annually and it is quite probable that in its more chronic and benign forms, the majority of the cases escape observation.

There are large contiguous areas in this country where anthrax exists enzoötically and as, in at least part of this territory, a rather dense hog population is normally maintained, a certain anthrax morbidity can be reasonably expected.

That the incidence of swine anthrax in Germany is apparently much higher than in the United States must probably be attributed to the fact that the latter does not, to the same extent, import raw materials of animal origin, such as bones, from the Orient and other regions and which eventually are apt to find their way into commercial feed stuffs.

It seems quite probable that aside from the cases of anthrax in swine which result from mere carelessness, the disease in this country does not exact a heavy toll from its swine-growers. On the other hand, the disease presents certain potentialities other than the immediate economic one and these give it a more than casual importance. Hence, in my live stock sanitary scheme to prevent and to control anthrax in general the malady in swine should also receive full consideration.

Causes

Anthrax in hogs is caused by the same microbic factors as in other animals.

The tendency of the swine disease to assume a more or less chronic form or even to occur as a latent infection, enables the animals thus involved to become instrumental as spreaders and may for the same reason present something of a public health problem.

Swine, as a rule, acquire the infection by the introduction of anthrax bacilli into the alimentary tract. This may come about by intimate contact with anthrax-bearing soil but probably oftener by the ingestion of contaminated foodstuffs. Evidence has been presented that the notable increase of chronic intestinal anthrax in Germany could be attributed to the feeding of fish meal to which bone meal was added, which had been prepared from imported raw materials. In this country, the rather com-

mon practice of feeding the carcasses of cattle to swine is, without doubt, the most frequently observed mode of transmission.

Symptoms

Anthrax in swine may present itself as an acute septicemic disorder or as a more or less chronic malady.

In the acute cases, general systemic symptoms are usually observed after an incubation period of from two days to one week. The affected swine are listless, dull and as they do in other acute diseases of the species, the animals tend to secrete themselves in the litter. There is a considerable degree of depression, the appetite fails and the body temperature is apt to range between 105° and 107.5° F. As an accompaniment of the fever, an increased respiratory frequency is usually observed and the pulse rate is also well above the normal. Muscular trembles (chills) are often noted and various observers have called attention to the presence of icterus, apparently associated with duodenal involvement.

In perhaps the greater number of cases of swine anthrax observed in this country, the acute manifestations are accompanied by disturbances of a local character, arising from the presence of pharyngeal or tonsillar primary lesions. The parts affected present edematous tumefaction, often progressively extending to the submaxillary space, the neck, the axillae, the pectoral region and occasionally even to the abdomen.

The skin covering these areas may be marked by dark red or livid patches. The parts are hot to the touch, without being particularly tender when pressed upon. As a result of mechanical obstruction thus brought about, deglutition becomes difficult and respiratory distress may be shown by a loud, snoring sound. Head and neck are rigidly extended and the mucosae as well as the skin becomes cyanotic. The animals struggle for air, strangle and attempt to vomit.

As a rule, the evolution of this form of swine anthrax is a rapid one and death is apt to occur in from 12 to 36 hours. However, recovery, even of the more alarming cases, is by no means exceptional. Glässer[5] states that not less than 20 per cent of the cases recover without treatment.

In the cases of swine anthrax in which the infection entered through the intestines instead of through the pharynx, the local phenomena described above are absent. In this type the general systemic symptom complex is not uncommonly accompanied by such digestive disturbances as nausea, diarrhea or constipation,

which may or may not be conspicuous in accordance with the character and extent of the intestinal involvement.

In the chronic forms of anthrax with lesions of a purely local nature, as a rule, no distinct clinical manifestations can be observed. In the majority of such cases the swine present no evidence of sickness at all. The lesions may come to light only in the abattoir and Miessner and Lütje[7] called attention to the fact that many such cases had never shown evidence of illness.

Lesions

Either a less marked susceptibility or a more active resistance on the part of swine is accountable for the fact that the pathoanatomic picture of the malady is apt to present a greater variety of changes in this species than in other farm animals. Whereas, in the latter the disease is usually of an acute, septicemic type, leaving but little time for the development of specific manifest changes, in the case of swine, a less rapid course, a more marked tendency toward chronicity and local lesions may engage the observer's attention. Even in the more acute cases of swine anthrax, local lesions commonly indicating the ports of entrance of the infection are often seen.

Aside from these the phenomena of acute disease of the more susceptible species may be revealed. They are the tarry, liquid blood and the conspicuous congestion and enlargement of the spleen. In addition, a degree of damage to the parenchyma of liver, kidneys and heart may be noted. As a rule, such necrobiotic changes are cut short by early death and do not result in pronounced lesions.

In anthrax of hogs, primary local lesions are most commonly associated with the pharynx and adjacent parts, as well as with the intestines. They vary in extent and intensity in accordance with the acuteness or chronicity of the disorder as presented in the individual cases. They may appear as local or independent manifestations or as part and parcel of an acute systemic infection.

As observed in the pharynx and the peripharyngeal structures, the lesions manifest themselves by swelling and a more or less intense hyperemia. The parts may be intensely inflamed and are commonly marked by a very conspicuous edema which is apt to involve a considerable area.

The tonsillar tissues are commonly the seat of primary infection and the mucosae are frequently covered by a fibrinous exudate and marked by petechial and ecchymotic hemorrhages.

The latter may be extended to the integument covering the parts.

The intense hyperemia may be focal and then take on the form of small carbuncles. The inflammatory reaction often results in necrotic changes and the formation of vesicles. Shallow ulcers are frequently seen. The necrotic areas have a brownish or yellowish gray color which tends to assume a lighter tint as the disease endures. Upon section they present a rather dry consistency, a light pastel coloration and, as a rule, they are firmly attached to the surrounding structures.

Intestines: When the intestine supplied the site of inoculation, large and small lesions may be observed, especially in the duodenum and jejunum. Such changes may be slight and localized in some cases, whereas in others several feet of the gut may be involved. An intense enteritis may come under observation, which commonly presents a serohemorrhagic or hemorrhagic-necrotic character.

The affected mucosa is dark red and swollen, the changes frequently being confined to a certain section of the bowel only. The inflamed mucous membrane is somewhat raised above the level of the normal lining and frequently it is sharply delimited from the latter. Some hemorrhagic areas may be observed.

In the more or less prolonged cases, hemorrhagic-diphtheritic lesions may be seen and occasionally a hemorrhagic fluid fills the intestinal lumen. Owing to a progressive inflammatory process, the intestinal wall is prone to become thickened, rigid and, with a rounded lumen, may come to resemble a piece of garden hose.

Necrotic lesions are frequently encountered. They may be small and circumscript or covering extended areas. Ulcers with ragged edges and a hemorrhagic or grayish base may thus be formed, especially near the mesenteric attachment. In some cases only one small ulcer may be found. The area involved is at first marked by a light red color which deepens into a dark red or brownish tint and finally assumes a slate-like coloration.

The ulcers are commonly preceded by the formation of an eschar apparent from the serous surface by a reddish gray or yellowish gray coloration. In the course of time, such eschars are apt to be cast off, after which healing may proceed. In that case cicatrization follows which, upon completion, leaves an irregular scar with contracted margins. When cicatrization is extensive it may cause intestinal stenosis accompanied or not by peritoneal adhesions.

The serous coat of the intestine may not present any lesions at all, but occasionally small areas of a deep red color may be

observed, most commonly at the level of Peyer's patches. In cases of some duration, a loosely attached fibrinous exudate may cover the serosa and even a plastic peritonitis may develop by which the intestinal coils become soldered together. In others small star-shaped scars may be seen, usually opposite the side of an intestinal ulcer.

The mesentery may be found without marked changes even if the lymph-nodes are thoroughly involved. When the mesentery does participate in the pathologic process, its blood and lymph-vessels are seen to be distended and the space between the mesenteric layers may be filled with a yellow serous fluid.

Occasionally an intestinal ulcer leads to perforation and then gives rise to an ichorous peritonitis, while secondary microbic invasion may result in abscess formation in which a fetid purulent material may be a marked feature.

Lymph-nodes: The lymph-nodes regional to the affected parts nearly always, although not constantly, become involved in the infection. The latter gives rise to a hemorrhagic fibrinous necrotic lymphadenitis. The affected lymph-node is often markedly enlarged and especially the nodes which receive the lymph drain of the pharynx and adjacent structures may appear as from two to five times their normal size. They are commonly distinguished by a dark, brownish red color and upon section they reveal a hemorrhagic and edematous interior.

In the more acute cases the entire lymph-node may be involved, whereas in the more chronically developing ones, only certain parts may present evidence of a pathologic nature. Particularly in the more chronic intestinal anthrax of swine the lesions may be confined to a single node only and even then the involvement may be a partial one. Such lesions are not always readily to be found.

Necrotic changes in the involved node may be an early manifestation. The dark red color of the organ then becomes lighter, brick-red or pinkish and finally assumes a grayish yellow tint.

The necrotic process may pertain only to a limited portion of the lymph-node, the diseased part being separated from the normal tissue by a yellowish line of demarcation. The consistency of the node gradually changes. Its tissue becomes drier and under the influence of pyogenic or other microbic invaders may finally soften. Part or all of the lymph-node may thus become affected and the node gradually becomes surrounded by a dense, connective tissue capsule.

Spleen: In the acute, septicemic cases of hog anthrax the spleen may present the same changes as may be observed in other

animal species similarly affected. The organ is greatly enlarged and intensely hyperemic. Its pulp, enclosed in a tense capsule, is of a blackish red color and of a softened consistency. Upon incision the pulp wells up from the intertrabecular spaces and a tarry blood exudes from the cut surface.

On the other hand, in the more chronic forms of the disease, the spleen may not display any gross lesions. However, in a part of the cases of swine anthrax, nodular formations of a very dark red color may be seen, either within the substance of the organ or hemispherically projecting from its surface. These so-called carbuncles have a rather firm consistency and when incised they present a dry appearance. These infarct-like lesions are the result of a localized hemorrhagic-necrotic inflammatory process.

Other organs: Aside from the parenchymatous changes, occasionally observed in the kidneys, liver and heart, anthrax lesions in the organs other than the ones mentioned are not commonly observed. In rather rare instances they have been observed in the lungs, and hemorrhagic areas are occasionally observed in the renal cortex.

Diagnosis

In the acute form of the malady, in which blood and spleen show the changes peculiar to anthrax, the causative microbe can be readily demonstrated in various organs. In the chronic cases, on the contrary, a marked paucity of the bacilli is a rather usual feature. For the purpose of a bacterioscopic diagnosis in cases of this type, recourse must be had to material obtained from such local lesions as may be supplied by the retro-pharyngeal or mesenteric lymph-nodes, as well as by the carbuncular foci in the spleen.

The bacilli observed in smears from such organs are frequently conspicuous by an unusually thick capsule and by a marked variation in their affinity for the stains applied. Organisms of classical morphologic appearance and well stained are seen commonly enough, but among them there are bacilli in which the chromatin substance is unevenly distributed. Intensely stained, irregular clumps and granules are apt to be observed in the bacillary body (pycnosis).

Other types in which the bacilli are formed into chains of extraordinary length, often occurring as long, flexible filaments, may be seen. A common observation pertains to anthrax bacilli which are but faintly stained or not at all. In the latter case the microbes appear as empty capsules owing to the complete disintegration of the chromatin substance. Such microbic forms

are apparently involved in degenerative changes or even death, which may be attributed to the action of the defensive substances present in this more or less refractive animal species.

As a general rule, anthrax bacilli are entirely absent from the blood of the chronic cases. Nor are they to be found in the normal-appearing spleens of swine thus affected. In such cases the retropharyngeal and mesenteric lymph-nodes, particularly the former, may supply the most promising material for a bacterioscopic examination.

In the cases in which the bacilli cannot be demonstrated microscopically, culture methods and animal inoculations may be successfully resorted to.

The anthrax bacilli gradually disappear in the course of the healing process, the microbes perishing under the influence of the cellular and fluid elements by which the body of swine defends itself against such invaders.

A prompt clinical diagnosis, even of acute anthrax, is not always possible and frequently must remain a tentative one when only objective symptoms have to be depended on. More secure in his suspicion of anthrax is the veterinary diagnostician, when, in anthrax territory, a number of swine sicken after having partaken of a bovine carcass dead of unknown causes. If such swine also manifest acute pharyngeal involvement, an accurate diagnosis of anthrax becomes possible.

The diagnosis of chronic anthrax in swine is even more difficult, if not utterly impossible, when clinical manifestations only can be considered. If autopsy material has already become available, the possibility of a correct diagnosis becomes materially enhanced. The lesions already described are always highly significant, even if not always conclusive without resorting to bacteriologic methods.

Differential Diagnosis

Swine erysipelas and hog cholera have occasionally been mentioned as possible problems in differential diagnosis. In connection with the former, certain skin lesions and the absence of necrotic changes in the lymph-nodes should, as a rule, prevent error. The presence of acute pharyngeal and peripharyngeal involvement speaks for anthrax, rather than for any other of the acute swine disorders. In cases of swine erysipelas, the spleen is often moderately enlarged, but the intensely hyperemic swelling and the dark tarry blood of anthrax cases do not occur in this malady. Certain nodular formations and infarcts in the spleen of erysipelas cases may constitute a source of confusion

in their differentiation from the splenic carbuncles seen in anthrax. In such cases the bacterioscopic examination will, as a rule, prove to be decisive.

In uncomplicated hog cholera, necrotic lesions of the lymph-nodes are not observed. When complicated with suipestifer infection, necrotic changes in the mesenteric lymph-nodes may be observed. As a rule, they are caseous, softened and do not resemble the dry appearance of the ones presented by anthrax cases. In the latter the lymph-node involvement is nearly always observed in those regional to the affected organs, whereas in hog cholera the more remote body lymph-nodes, such as the submaxillary and inguinal ones, are also apt to show the hemorrhagic changes peculiar to this disease. There the tendency to various hemorrhagic lesions throughout the body and the viscera should also serve as a means to rule out an anthrax infection.

TREATMENT

In the treatment of swine affected with acute anthrax the prompt injection of anti-anthrax serum is indicated, although in the more rapidly progressing form of the disease all attempts at therapy may be of no avail. Although some writers have reported good results from the internal administration of creolin, it seems very doubtful that anything can be accomplished by medicinal treatment. A certain proportion of the swine tends to recover without any therapeutic intervention at all and it is by no means improbable that this tendency is more accountable for the recoveries than any non-specific treatment.

For the purpose of prophylaxis, vaccination, combined or not with serum injections, has been found to yield satisfactory results. As a further attempt at prevention, especially in anthrax territory, the feeding of carcasses should be discouraged, as in this country, at least, the greater part of the cases of acute anthrax in swine can be traced to this source.

Although the economic losses due to anthrax in swine may not be great and are largely avoidable, the tendency of the disease in this animal species to assume a chronic form, not accompanied by manifest clinical phenomena, strongly suggests the possibility that affected swine may become instrumental in the establishment of new foci of infection.

Notwithstanding the fact that the anthrax bacilli in such hogs are never numerous and contained only in lymph-nodes, they will, in the presence of open lesions in the alimentary tract, be eliminated with the feces. Soil, foodstuffs and water supplies may thus be contaminated with the always possible result of the

disease appearing among the live stock on farms quite remote from known anthrax districts.

What the extent of such a hazard may be is not known at the present, but its existence cannot be gainsaid. Within recent years, outbreaks of anthrax, in which cattle, swine and humans were involved, have been observed in a number of hitherto exempt places, far removed from recognized anthrax territory. It has not been possible to determine the manner by which the infection was transmitted. The uncontrolled movements of vehicles now largely used in the shipment of hogs and other live stock, and which operate over long distances have, of course, been suspected, but dependable evidence has not become available. The possibility that in addition to such inanimate carriers, live ones must also be given consideration if the problem of anthrax dissemination is to be adequately solved.

The public health relations of swine anthrax are likewise of importance. From time to time, chronic intestinal or lymph-node lesions have been encountered by the meat inspection service. In abattoirs which receive swine from anthrax territory, vigilance in this connection should never relax, not only as a public health measure, but also in order to identify the swine concerned and their place of origin. State live stock sanitary departments should then be promptly notified so that eventually adequate control measures may be inaugurated.

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