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Clostridial Diseases Encountered In Veterinary Medicine

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ALTHOUGH one of the Clostridial diseases of animals has been recognized as a distinct entity for 70 years, knowledge concerning disease caused by infections due to this genus of bacteria seems to have lagged somewhat as compared with some of the other bacterial diseases. The reason for this apparent lag is obvious. Symptoms and pathological lesions associated with Clostridial infections usually result from the effects of toxins which enter the bloodstream. The fact that the actual site of infection is often quite remote from the site of greatest injury may, of course, be confusing to the investigator.

Then, too, because of the differences in nutritional and environmental requirements of these organisms, even within a single species, methods that prove satisfactory in working with one type may be useless when applied to another. Isolating, growing, and producing optimum toxins with these fastidious organisms, in the absence of oxygen and frequently in deep nontransparent media, is quite different from working with some of the more easily cultured aerobes. The frequency and severity of infections caused by Clostridia during World War I, however, stimulated investigations in this field, and most of our knowledge concerning them has been gained since that time.

Since all Clostridia produce spores which are resistant to environmental factors usually found in soil, they are sometimes referred to as being soil-borne. Most of these organisms have widespread distribution, and once premises become infected they may remain so for a long period of time.

**Blackleg**

Blackleg, the result of Clostridium chauvoei infection and the first Clostridial infection recognized in veterinary medicine, is widely distributed. It is common in the plains and intermountain states. There are some areas, the eastern and southern gulf states and at least part of the Pacific slope, where the disease is not a problem. This is a disease of young cattle in good condition, usually affecting those between the ages of six months and two years. Sheep, goats, and hogs may occasionally become infected. The course of the disease is rapid, consisting of severe lameness, with a marked crepitating swelling occurring in the affected quarter. There is a high body temperature. Death usually occurs within 24 hours. On autopsy the affected tissues are found to be edematous, hemorrhagic, and emphysematous, with some variations in appearance and consistency due to pressure. A characteristic sweetish odor is present in freshly-cut affected tissues.

Blackleg bacterin, prepared by growing the culture in liquid medium followed by treating with formalin, which kills the organisms and unites with the toxin-forming toxoid, and alum, which intensifies the antigenic properties, is a highly satisfactory product for immunization and is extensively used.

**Malignant Edema**

*Cl. septicum* is capable of producing symptoms and lesions in cattle similar to...
those produced by *Cl. chauvoei* infection. When this occurs in animals previously vaccinated with blackleg biologics, the immunization for blackleg may be doubted. Differentiation of the two infections can be made only in the laboratory. The author has had the experience of having infected tissue juices becoming non-viable when kept in the refrigerator 72 hours. This may account for some negative diagnoses when specimens are shipped some distance to the laboratory.

*Cl. septicum* is frequently encountered in open wounds and produces that type of infection known as malignant edema. Horses, sheep, and cattle are susceptible. The course of the disease is acute, usually terminating fatally. The wound is surrounded by a hot, painful, crepitating, rapidly spreading swelling. Gas and exudate bubble from the wound. There is a marked elevation in the affected animal's temperature. Death usually occurs within 72 hours.

It is impossible to differentiate between *Cl. septicum* and some of the other Clostridial infections in the field, but favorable response to sulfonamide or penicillin therapy can be expected if treatment is instituted before irreparable damage has occurred.

*Braxy*, a disease of sheep first reported by Gaiger in the British Isles and since then recognized in Denmark, Germany, and Iceland, is caused by the invasion of the wall of the abomasum by *Cl. septicum* where it reproduces rapidly, producing a very lethal toxin. An inflammatory patch on the stomach wall is the characteristic lesion. This is a very acute disease, the animals dying without showing pronounced symptoms. A formalized bacterin antitoxin has been satisfactorily used as an immunizing agent.

In the United States, braxy has not been reported as causing serious losses. Niemann and Vawter have reported the isolation of *Cl. septicum* from sheep's stomachs in Wisconsin and Nevada, respectively.

**Botulism**

While *Cl. botulinum* is widely distributed, it apparently does not cause such severe losses as were previously attributed to it. This is especially true in the case of horses where the identification of the etiological factor of encephalomyelitis has somewhat clarified the thinking concerning so-called forage poisoning.

Five types of *Cl. botulinum*, A, B, C, D, and E, are recognized, the different types producing somewhat different toxins. In cattle most trouble is encountered in areas where herbage is deficient in phosphorus, and the animals feed on carcasses in an effort to obtain the desired phosphorus from bones. This condition has been reported as occurring in South Africa, Australia, and Texas. Most of this trouble has been attributed to type C. Providing bonemeal prevents losses.

Outbreaks known as "limberneck" occur in chickens when the birds are fed spoiled canned food contaminated with the causative organism. Serious losses in ducks and other wild birds inhabiting alkali lakes of western United States have been caused by type C. Many affected birds recover if their digestive tracts are flushed with fresh water.

**Bacillary Hemoglobinuria**

Our information concerning bacillary hemoglobinuria is largely the result of the classical contributions of Records and Vawter of Nevada. While this condition is primarily a disease of cattle, sheep and even hogs are sometimes affected. It is due to infection with *Cl. hemolyticum*. The disease in cattle has been recognized in California, Idaho, Nevada, Oregon, Montana, Utah, Texas, Mexico, and Chile. It occurs mostly during the summer in poorly drained areas of the intermountain area and the Pacific slope.

Symptoms develop suddenly and consist of cessation of digestive activity, shallow, labored breathing, and a tucked-up, painful attitude. A bloody diarrhea sometimes occurs as the disease progresses. The body temperature may reach 106°F. Because of the presence of hemoglobin the urine is dark red in color. The course of the disease averages about 36 hours, mortality being over 90 per cent in animals not receiving antiserum treatment.

In post mortem the subcutis is found to
be hemorrhagic and icteric. The pleural, peritoneal, and pericardial cavities contain excessive bloody fluid. Subendocardial hemorrhages are frequent. The intestines are usually more or less hemorrhagic. A characteristic lesion in the form of anemic infarct is found in the liver. The kidneys are usually darker in color than normal, and may show petechial hemorrhage.

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Treatment consists of the intravenous administration of 500 cc. antitoxic serum, and stimulants. If treated before irreparable damage has occurred, recovery may be remarkably rapid. Bulls and some other animals may require a second injection of serum. Formalized alum precipitated toxoid-bacterin has been used successfully to immunize cattle in the field and is available commercially.

Wavter has also reported the isolation of \textit{CZ. sordelli} from cattle infected with \textit{Cl. hemolyticum} and \textit{CZ. perfringens}, and from sheep infected with \textit{Cl. septicum}.

**Tetanus**

Tetanus (lockjaw) is a true toxemia, the result of wound infection with \textit{Cl. tetani} which is apparently widely distributed in nature. Infections by this organism, however, are more common in some areas than others. The disease is quite rare in the North Pacific slope region. Horses, sheep, and goats are most susceptible, the disease frequently following operations such as docking and castration. Symptoms are characterized by spasmodic contractions of the skeletal muscles.

Treatment with hyperimmune serum is of questionable value in most advanced cases, but is a good prophylactic agent if used before symptoms develop. Alum precipitated toxoid is an excellent immunizing agent if there is sufficient time for the development of antibodies before infection is encountered.

**Black Disease**

Infectious necrotic hepatitis (black disease) of sheep, the result of \textit{Cl. novyi} infection, was first reported by Turner as occurring in Australia. During the past several years it has been recognized in Montana, Oregon, and several other western states.

This disease is unique in that the portal of entry in the animal is usually made by immature liver flukes. A few exceptions have been noted, but this is primarily a disease of fluke regions.

Mature ewes in excellent condition are most frequently affected. Death is so sudden that symptoms are practically absent, the animals usually dying in natural resting positions. Upon skinning the animal, the subcutis is found to show severe congestion and hemorrhage. This results in a dark discoloration of the hide upon drying, which suggested the name of “black disease”. The lungs usually appear quite normal, although there may be some congestion. Excess pleural and abdominal fluid is present. The pericardial sac is constantly distended with more or less clear fluid containing a “chicken fat” clot. The liver is congested and contains one or several necrotic areas varying in size, often 2.5 cm. in diameter. If bacterial examination is made of these areas, which result from fluke injury followed by bacterial invasion, \textit{Cl. novyi} will be found packed in the necrotic tissue. The abomasum and first part of the small intestine are frequently congested. The kidneys show congestion and may become pulpy if autopsy is delayed a few hours after death.

\textit{Cl. novyi} is one of the most strict anaerobes and is very fastidious as to growth requirements. The organism quickly loses its ability to produce toxin in artificial media, which makes production of satisfactory toxoids difficult.

Formalin-killed whole cultures, bacterins, alum-precipitated toxoid and alum-precipitated killed cultures have been used as immunization agents. The advantage of the alum-precipitated toxoid over the formalin-killed culture is that it may be used safely during an outbreak of the disease. An “aluminum hydroxide absorbed” bacterin which has proved satisfactory in field use in available commercially.

**Lamb Dysentery**

A severely fatal disease of lambs characterized by dysentery during the first 10 days of life has been reported by Dalling as occurring in the British Isles. \textit{Cl. per-
f. type B is the infective agent. Losses are prevented by the administration of Cl. perfringens type B antiserum. Tunnicliff has also reported the isolation of a strain of Cl. perfringens from cases of lamb dysentery in Montana which he incriminated as being the offending organism. This organism differed in some respects from the one studied by Dalling. Losses are prevented by the use of antiserum.

Struck

McEwan has reported on a disease in sheep occurring on the Romney Marsh in England that is characterized by sudden death and in which Cl. perfringens type C has been incriminated. The disease occurs during late winter and early spring. Symptoms and lesions are quite similar to those found in enterotoxemia due to type D.

Enterotoxemia

First reported by Gilruth in New Zealand, enterotoxemia of sheep received considerable attention during the past 15 years. Bennetts in Australia was first to determine the etiological factor of the disease, incriminating Cl. perfringens type D. This disease has since been recognized by Oxer in Tasmania, Montgomery and Rowlands in North Wales, and Gill in New Zealand. In the United States Bough ton and Hardy in Texas, Shaw, Muth and Seghetti in Oregon, and Harshfield, Cross, and Hoerlein in Colorado have recognized the disease. A somewhat similar if not identical condition has been reported by Wing in New York, Bell in Ohio, and Britton and Cameron in California. Enterotoxemia results from the rapid proliferation of Cl. perfringens type D in the small intestine and the absorption of the toxin there produced. Lambs are affected at two approximate ages, namely, when they are from three to four weeks of age and when they are from three to four months of age. Animals affected are usually on excellent pasture or concentrated feed. Those in the best nutritional condition are most frequently affected. Losses as high as 30 per cent have been observed. Death is sudden and symptoms seldom observed. When observed, they consist of dyspnea, apparently severe abdominal pains, and coma. Mortality approaches 100 per cent.

If autopsy is performed two hours after death one finds congestion of the lungs, subendocardial and subepicardial hemorrhage, and a varying amount of enteritis. The kidneys are swollen, congested, and frequently have the consistency of jam. The epsilon toxin of Cl. perfringens type D can be demonstrated in the contents of the small intestine. Outbreaks of this disease are definitely associated with lambs on a high nutritional plane. Withholding feed will stop losses. Sheepmen, however, are reluctant to practice the withholding of feed since they are interested in maximum weight gains. The disease can be controlled by the use of biological products. Both antitoxin and toxoid-vaccine have been used. While not yet available commercially in the United States, they have been on the market for a number of years in Great Britain.

Conclusions

The recent development of transparent culture media that do not require enclosure in an oxygen-free chamber, and the perfection of simply operated, reasonably safe, anaerobic chambers have greatly simplified the isolation and culture of Clostridia which makes laboratory diagnoses of these infections less laborious and time-consuming. The development of better immunizing products, especially alum-precipitated toxoids, has provided methods for controlling losses from most of these infections. The sulfonamides and penicillin, both of which are effective against Clostridia, are proving useful in combating some infections due to these organisms. With these facilities the practicing veterinarian is much better equipped to cope with the diseases caused by Clostridia than he has been in the past.

REFERENCES

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Two thousand years ago urine was a favored mouth wash and dentifrice by the medical profession and it has retained its preference to the present day with the more ignorant of backward peoples. Now scientific research demonstrates the effectiveness of urea as a treatment for pyorrhea.

An acidophilus milk paste, quite effective in the healing of wounds, has been developed by Soviet microbiologists. This milk paste has proved successful in Leningrad hospital in slow healing wounds which failed to respond to novocaine blocking, ultraviolet ray treatment, antiseptics or permanganate baths.

According to the U. S. Department of Agriculture, mineral oil when ingested prevents the absorption of two fat-soluble vitamins, A and D, and two important minerals, calcium and phosphorus. Prolonged use of mineral oil may lead to deficiencies. In experiences at the Arizona station rats taking mineral oil required three times as much cod liver oil to supply the vitamin D required as did rats not given the oil. Puppies fed mineral oil could not use the calcium and phosphorus in their feed to build a normal skeleton.

Ampules of thrombin are included in Soviet soldier's field service dressings. A gauze pad soaked in thrombin applied to wounds will stop the hemorrhage in three to five seconds. The thrombin used is prepared from horse serum.