Enterotoxemia in Cattle

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Introduction

I. Enterotoxemia is an acute infectious but non-contagious disease caused by the toxins of *Clostridium perfringens Type D or C*, or both and characterized by sudden death. This disease is often suspected and diagnosed clinically quite frequently in feedlot cattle. A definitive diagnosis is difficult in most cases.

II. There are four very common types of *Cl. perfringens;* they are A, B, C and D.

1. Type A is believed to be involved in animal disease but its true assessment at this time is far from clear.
2. In Great Britain, organisms of Type B, which produce alpha, beta and epsilon toxin, cause lamb dysentery and problems in young calves.
3. In the United States, organisms of Type C, which produce beta and alpha toxin, were identified as the cause of hemorrhagic enterotoxemia in young calves. Type C has also been known to produce hemorrhagic enterotoxemia in lambs and baby pigs - "struck" in sheep in Europe.
4. *Cl. perfringens* Type D, which produces alpha toxin and epsilon toxin, can cause enterotoxemia, a disease of primary importance in sheep which has been well defined. There is overwhelming evidence to indicate that similar circumstances and situations occur in cattle which simulate the sheep enterotoxemia syndrome. Toxins from both *Cl. perfringens* Types C and D have been isolated from cattle in suspected cases of enterotoxemia.

III. *Clostridial perfringens* type organisms have wide distribution in soil.

A. Some investigators feel the organisms enter the digestive system by the contamination of food and water. Others believe they are a natural inhabitant.

1. The higher percentage of the organisms are destroyed in transit through the rumen and abomasum.

2. In the ileum these organisms which survive produce toxins.
3. The host animal may suddenly ingest large amounts of high caloric concentrate consisting of starch granules which pass into the small intestine and the clostridia multiply very rapidly. It is under these conditions that toxins are produced and absorbed and produce characteristic lesions and rapid death of the animal.

IV. We will confine our discussions today to *Cl. perfringens* Types C and D.

A. Beta toxin produced by *Cl. perfringens* Type C is actively necrotizing and probably also neurotoxic.

a. It is responsible for inflammation of the intestine and wholesale loss of the mucosa.

b. *Cl. perfringens* Type D produces alpha and epsilon toxin; however, it is not produced as such by strains of D but rather, is produced as a relatively non-toxic prototoxin that is rendered highly toxic by treatment with proteolytic enzymes such as trypsin.

1. Griner pointed out that epsilon toxin affects the central nervous system primarily.
2. There is an initial increase in vascular permeability in the brain followed by softening and liquefaction necrosis which generally occurs within a few hours after the first symptoms of epsilon intoxication.
3. Other effects of epsilon toxin in the body and one that is most important in the pathogenesis of the disease caused by Type D strain is its ability to increase cellular permeability in the intestine.
4. Normally the intestine is relatively impermeable to epsilon toxin as it is to most proteins. After epsilon toxin has been in contact with the mucosa of the intestine, however, the intestinal wall becomes appreciably more permeable to proteins including epsilon toxin. Experimentally, a single large dose of epsilon toxin may be given by mouth without impunity. It passes rapidly down the alimentary tract without being absorbed. If this dose is given in several portions, however, a lethal amount may be absorbed. The first portion given will pass down the intestine, leaving behind it intestinal wall that is permeable enough to allow the absorption of a lethal dose of toxin.

V. Several diagnostic laboratories have reported that the higher incidence of enterotoxemia in cattle is in subjects **900 lbs. or heavier.** Other laboratories have reported the disease in lighter cattle but in cattle doing extremely well.

A. They have also reported that it has been seen in high performance cattle which may be younger but on a very intensive feeding program.

1. It has been reported in about 10 to 20% of Iowa's feedlots, however, it seldom involves more than 2% or 3% of the cattle in those lots.

VI. *Predisposing factors to disease*

A. Husbandry

Some individual cattle feeders try to bring the cattle on feed too rapidly. This often provides gastro-intestinal upset.

B. *Weather conditions are prime factors in certain feeding areas.*

1. Sometimes feed will get wet, the animals will pull back and then we have extremely hungry animals and they overeat.
2. In Iowa and Minnesota particularly, snow and cold may keep the cattle away from the feedbunks. When they return, they again overeat and the disease occurs.
3. Anything which disturbs the eating habits of the cattle on feed and causes them to go off feed, come back and overeat, will certainly provide a proper predisposing situation.
4. We must remember with high concentrate feeding that starch granules may enter the small intestine and set up or provide the proper media for rapid growth of *Cl. perfringens* organisms already present.

VII. *Lesions observed in enterotoxemia.*

1. Very possibly hemorrhagic enteritis - mucosa and serosa.
2. Very dramatic hemorrhages on the epicardium and diaphragm.
3. Histopathology would reveal necrosis of the intestinal mucosa and also hemorrhage. Histopathology may reveal a **degree of nephritis** but more appropriately the invasion of the lamina propria of the intestine by gram positive bacilli and an inflammatory response to those bacilli indicating activity in the ante-mortem state. Histopathology will sometimes reveal edema of the brain and lungs.

VIII. *Handling of tissues and specimens*

We must indicate that it would not be worthwhile to post an animal suspected of having died of enterotoxemia that has undergone very much postmortem autolysis.

A. *Cl. perfringens* is normally found in the gastrointestinal tract of ruminants. When the animal dies there are anaerobic conditions provided because the oxygenated supply of blood to the intestine is cut off. This favors an overgrowth of *Cl. perfringens*, of course, which is a common saprophyte that aids nature in tissue decomposition. There is an inverse relationship between decomposition and significance.

B. The toxins are very labile.
   1. Some laboratories will want the contents of the ileum poured out and frozen in a separate container.
   2. Others will want the lesion area tied off (or the gut area) and refrigerated. Usually they require about 18" of small intestine. Organs such as liver, kidney and spleen should be submitted.
   3. Of course, the small intestines, as previously mentioned, and any muscle tissues showing dramatic hemorrhage should be provided. This is done to determine whether other clostridia may be involved.

C. *Diagnosis of enterotoxemia*
   1. Suggestive history; that of animals on full feed and probably stressed and thrown off feed and coming back on feed. Also, climatic conditions are very important.
   2. Dramatic hemorrhages on the heart and diaphragm and possibly even pulmonary edema.
   3. The isolation of *Cl. perfringens* in virtually pure culture from the small intestine of a fresh animal.
   4. Histopathology showing invasion of lamina propria and a corresponding inflammatory response to those organisms.
   5. The absence of isolation of *Cl. perfringens* from other organs and tissues.
   6. The demonstration of toxins and typing of these toxins by mouse inoculation test.

IX. *Control*

A. Husbandry is very important in the prevention of this disease.
   1. Keeping the animals on feed and avoiding stress factors as much as possible.
   2. Protection from weather is an important consideration and also protection of the feed against moisture and snow to prevent the animals from eating and then coming back and overeating.

B. Double vaccination of pregnant dams.
   1. With *Cl. perfringens* toxoid C and D to provide transfer of the maternal antibodies to offspring.

2. Antitoxin to young animals.
3. Double vaccination of cattle with C and D toxoid during the acclimation period previous to placing on full feed.

Conclusions

There are still gaps in our knowledge. While the determination of enterotoxemia is not easy we have a good working knowledge to place at the disposal of the agricultural community. In our efforts to control enterotoxemia in ruminants for immunization of sheep we have on hand products of proven ability. If they are produced to accepted standards it is reasonable to assume that these same products are the tools which will protect cattle. It is a question of deciding how best to use them in the circumstances which surround the occurrence of the disease in any particular herd. Although there is no clear definition of the cause of feedlot disease in cattle, it is understandable that on practical grounds veterinarians should wish to provide a cover against *Cl. perfringens* Type D and Type C. There is no evidence that a proportion of cattle carry a level of natural immunity which has arisen from the absorption of non-lethal doses of toxin from the intestine as occurs in sheep.

In these circumstances it is a risk to depend on a relatively low and transitory level of antitoxin which can be produced from a single dose of vaccine. Where possible, the first dose of vaccine should be given at least one month before the cattle enter the feedlot and the second on entry. Otherwise the first injection on entry should, in my view, be followed by a second one one month later and some days before really heavy feeding is practiced.