Necrobacillosis of Calves
(Calf Diphtheria)

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Necrobacillosis of Calves
(Calf Diphtheria)

By Cecil Elder, A. M. Lee, and L. H. Scrivner

Necrobacillosis is the name given to the various infections of domestic livestock which are caused by the Actinomyces necrophorus (Bacillus necrophorus). The condition is observed in calves as an acute specific infectious disease affecting the mucous membranes of the mouth and throat mostly and characterized by the formation of necrotic areas or patches which undergo a coagulation necrosis.

The disease has been known under various names such as necrobacillosis, necrotic stomatitis, calf diphtheria, etc. The latter name is somewhat of a misnomer, but because of its long and common usage we are using it in this bulletin. This name was given to the disease by early workers and has been passed on down to the present time.

Necrobacillosis, or calf diphtheria, is a very common disease in Wyoming and, over a period of years, has caused considerable loss to the cattle industry. As a general rule, it does not affect large numbers of animals at one time, but unless the condition is treated death usually follows in the cases that do occur. The disease spreads rather rapidly in the same herd of animals which are kept on contaminated ground, but it does not spread readily from one herd to a neighboring herd, as a general rule. Usually only comparatively few animals are affected at the same time, but we have in our work observed outbreaks of a very acute nature in which large numbers would be affected at the same time and in which losses were quite heavy. The disease occurs as an enzootic in all parts of Wyoming and is more prevalent some years than others, probably due to climatic and feed conditions.

Necrobacillosis is not necessarily confined to calves but affects, in one form or another, practically all species of domestic animals. It is responsible, in addition to the trouble it produces in calves, for lip and leg ulceration of sheep, foot rot in sheep, necrotic stomatitis
of lambs and pigs, some cases of umbilical infection in lambs, necrotic scratches of horses, gangrenous dermatitis of horses and nodular necrosis of the liver of cattle. It is also associated with necrotic enteritis of swine and "bull-nose" of swine. An organism similar to the one causing these conditions has also been found and described in several human lesions.

This bulletin will deal only with Necrobacillosis of calves.

HISTORY

Probably the first cases of this disease were reported by Dammann in 1876 from the shore of the Baltic. At that time he believed the disease to be identical with diphtheria in man. In 1884 Loeffler, working with diphtheria in man, isolated and described the specific organism causing that disease. About the same time he also isolated the causative organism of calf diphtheria and proved the two to be entirely distinct and separate. We now recognize that calf diphtheria has no relationship whatsoever with diphtheria in man, and the disease is not transmitted from one to the other.

CAUSE

The condition, Necrobacillosis, is caused by the Actinomyces necrophorus or Bacillus necrophorus, an organism known also by several other names. It is recognized as a common inhabitant of the soil and possibly is present normally in the intestine of healthy domestic animals. The bacillus is a pleomorphic organism occurring in several different forms. It varies in morphology from a small coccoid bacillus to a long slender filament sometimes 100 microns in length. In young cultures and in actively developing lesions many of the long forms may be observed. The short coccoid forms are more common in old cultures. All forms stain readily with the common aniline dyes and are negative to the gram stain. The staining reaction is quite characteristic in that the organisms are sometimes beaded in appearance. The long filaments contain areas which take a heavy stain and these alternate with rather large clear spaces which do not stain. At first these clear areas give one the impression that they are spores, but they are negative to the ordinary spore
staining techniques. The filaments vary in thickness, sometimes having enlarged portions in the centre of the filament, and at other times one end may be enlarged, the other tapered. The organism is a non-spore former, non-motile and easily killed by germicides.

CULTIVATION OF ACTINOMYCES NECROPHORUS

The organism is a strict anaerobe, and we have found it quite difficult to grow. Many techniques were tried and many different media used before we developed a satisfactory method of cultivation. We now isolate the organism in pure culture by one of two methods, namely, (1) direct from the lesion to culture medium using strictly fresh material or, (2) by first passing the material through rabbits and inoculating the medium from the rabbit lesion. On the first passage through rabbits, which requires about six to ten days to produce death in the animal, most of the extraneous organisms of the mouth are eliminated. The second or third passage through rabbits produces a relatively pure culture in the lesion which may be used for inoculating the culture medium.

We have found the best medium for isolation to be agar agar titrated to pH 7.0 to which has been added 10 per cent horse serum. This is used in deep “shake” cultures, the colonies developing in two to three days in the lower portion of the tube. The colonies are fished and transferred to cooked meat media and incubated at 37.5°C. In three to five days active growth has taken place with considerable gas formation and a disagreeable yet very characteristic odor. Plates and surface inoculations grown in the Novy jar have not been as satisfactory in our hands. Hagan has reported the formation of hydrogen peroxide by Actinomyces necrophorus in plates exposed to the air only a short time, and this probably accounts for the poorer results with this method of cultivation.

CHANNEL OF INFECTION

The Necrophorus organism apparently produces no harm on the unbroken skin and mucous membrane, but gains entrance only through breaks or abrasions. This accounts for the fact, as mentioned later, that we see the disease mostly in young animals because
there is a portal of entry at the time of the eruption of the teeth. Injuries by sharp pointed objects produce ideal points of entry. The most common among these are rough feeds, thorns, thistles, barley beards, fox-tail beards, etc. Especially important in Wyoming are the fox-tail beards or awns. It has been our observation that fox-tail is often present in the hay on ranches where this disease develops. Since the organism is a strict anaerobe it does not develop on the surface of the skin and mucous membrane, but burrows into the deeper tissues after gaining entrance through abrasions. The latter may be very small or even microscopic in size so that they are seldom noticed before infection takes place.

SUSCEPTIBILITY AND SEASONAL VARIATION

All breeds of cattle are susceptible, but calves which are kept up and fed around the corrals and barns are more often affected. This is because of the heavier contamination in those places and the greater likelihood of the animal picking up the infecting organism. Very young calves are most often affected, especially those under ten to twelve weeks of age although we have frequently observed the disease in older animals and even in yearlings and two-year olds. Calves but a few days old are often affected and generally in a very severe form.

Under Wyoming conditions we have observed the disease associated very closely with the colder weather, developing late in the fall, on an average about November, and extending through the cold months and especially the spring months when the weather has been severe. It seldom if ever occurs during the summer months when the cattle are on summer range.

It is generally considered that the organism causing this disease is associated with filth and insanitary conditions. This we have found to be true, but at the same time we have found it developing in animals kept under the best of conditions and in clean quarters. For the most part the greater amount of trouble is in herds kept in dirty surroundings where the manure and litter have been allowed to accumulate, especially when the season has been wet and stormy and the ground is covered with wet snow.
The period of incubation is from three to five days. The infection tends to localize at first, but, since the organism produces a toxin, general systemic symptoms are sometimes observed, especially in the septicemic and very acute types. There is first noticed in affected animals loss of appetite, languor, dejectedness, and slight elevation of temperature.

Swellings soon appear around the areas of infection which are generally confined to the mouth and throat as the disease has a tendency to localize. The areas become so sore that the animals are unable to swallow and often stand with a bunch of hay or grass in the mouth or hanging from the mouth. Such a condition is shown in Fig. 1. They may chew at this feed half-heartedly and finally drop it to the ground.

There is considerable drooling and one’s attention is directed to the mouth. Upon examination of the same one finds ulcers or necrotic areas varying in size and covered with a yellowish membrane which is removed with difficulty.
A very disagreeable yet characteristic odor arises from these necrotic areas. It is so characteristic that once one is familiar with it he can almost base his diagnosis on it alone. It has been described by some as smelling like a mixture of glue and cheese.

The necrotic areas are found most often on the tongue as shown in Figs. 2 and 3. The tongue may be so swollen as to protrude from the mouth. In aggravated cases we have observed tongues where the entire dorsal mucous membrane had been denuded. Necrotic areas or ulcers may also be observed on the inside of the cheeks, around the lips, around the gums, as illustrated in Fig. 4, in the angle of the jaw, on the hard palate, and even well down into the throat. Fig. 5 shows typical lesion on hard palate.

When the larynx or trachea are involved, as seen in Fig. 6, there is coughing and labored breathing accompanied by a considerable roaring sound. If the nasal cavities are affected one notices a thin sticky discharge around the nostrils and the usual disagreeable odor. Sometimes the jaw bone may be affected and the hard bony enlargement may be felt from the outside.

The necrotic areas are yellowish in color and sometimes have a brownish color around the edge. The areas around them are red and swollen. Covering the necrotic ulcer is a "diphtheritic" mem-
brane which is removed with some difficulty and when removed exposes a raw bleeding surface.

If the animal has been affected for three or four weeks and death has not taken place, the infection often gains entrance to the digestive tract or lungs by metastasis. When the digestive tract is involved one sees symptoms of diarrhea and extreme weakness. If the lungs become affected symptoms of broncho-pneumonia are evident. It has been our experience that when the digestive tract or lungs become affected, death usually results in a comparatively short time.

Sometimes the infection gains entrance to the skin between the claws of the foot and severe lameness follows. Foot rot or "foul" foot are caused by the Necrophorus organism. In all cases of necrobacillosis loss of flesh is very rapid. Death takes place as the result of absorption of toxin produced by the invading organism.

LESSONS

These have been described under symptoms and are observed during life as well as after death except where the internal organs are involved. The ulcers are covered with a yellowish, sometimes greenish and sometimes brownish, colored necrotic material which has undergone coagulation and caseation. In the lungs abscesses
are found containing a yellowish or yellowish green pus. Necrotic patches and ulcers are found on the mucous membrane of the intestine.

TREATMENT

Since the disease tends to localize on the mucous membrane and neighboring structures around the mouth and throat, attempts at treatment have been largely local. Examine the mouth and remove all accumulations of feed and foreign material. With a curette or blunt-pointed instrument scrape the necrotic areas, removing all dead tissue. These areas should be scraped until they bleed. Then wash the diseased area with any good mild disinfectant until thoroughly clean. Several treatments have been recommended to be used on affected areas after they have been cleaned. As has been reported previously in the Annual Reports of the Wyoming Experiment Station, we have found the best treatment to be a 10 per cent solution of potassium permanganate to which 1 per cent active chlorine has been added. We have prepared this by dissolving tablets prepared for making Dakin's solution in the
permanganate solution. Dakin's solution may be used after adding 10 per cent by weight of potassium permanganate crystals. Good results have been reported following the painting of affected areas with Tincture of Iodine. We have used this treatment with good success, but results have not compared with the permanganate solu-

Fig. 5. Lesion on Upper Jaw.

Fig. 6. Lesions in Upper Part of Respiratory Tract. It is Impossible to Treat Lesions in This Location.
tion. Other antiseptic solutions have been recommended such as 3-5 per cent creolin, 5 per cent phenol, 4 per cent boric acid, Lugol's solution of iodine and commercial cider vinegar.

Mouth washes have been recommended, but we have not found them very practical in treating this disease. Our best success has been where the solution was applied only to the affected area by means of a small brush or cotton swab on a stick. When the disease is first found it should be treated daily, but as healing takes place the treatments should be less severe and at longer intervals up to 3 to 5 days.

PREVENTION

Sick animals should be isolated and the contaminated barns and corrals cleaned and disinfected where practical. Feed contaminated by sick animals should not be fed to healthy animals and should be destroyed or sprayed with a good disinfectant.

The discharge of ulcers and the material scraped from necrotic areas should be destroyed by burning or placed in a vessel containing some good disinfectant. *Do not throw this material on the ground or into the manure and litter.* Such material contains large numbers of Actinomyces necrophorus and these live for long periods if protected from the air, as might be the case in the manure and litter. Carcasses of animals that have died from the disease should be destroyed, preferably by burning or by deep burial.

Up to the present writing we have found no vaccines or immunization products which are of any particular value as a prophylactic measure.

Exposed animals should be watched closely for several days for any evidences of the disease. Some have reported it to be very practical and beneficial to examine daily, for a few days, the mouths of exposed calves to determine at the earliest possible moment any indication of infection.
EXPERIMENTAL WORK

We have been working on this disease for several years at the Wyoming Experiment station and have been, in addition to securing the information published in the foregoing pages, attempting to work out some sort of an immunizing product which could be used for vaccination of calves and the controlling of this disease. We have succeeded in preparing an antiserum which will protect rabbits against experimental inoculations with Actinomyces necrophorus, but our results with calves have been negative so far. Filtrates and bacterins have also been prepared from a number of cultures obtained from field cases. Considerable work has been done with the filtrates and these give some promise of being useful in preventive treatment.
The following publications of the Wyoming Experiment Station may be had upon request. (Revised list August, 1931.)

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