

Calf Diphtheria—Waiting for the Right Opportunity

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Calf diphtheria, also called necrotic laryngitis or laryngeal necrobacillosis, occurs in young calves when certain bacteria infect the calf's mouth and the larynx (voice box). The calf's breath usually has a rotten, fetid smell due to the dying and rotting infected tissue.

Calf diphtheria is caused by a bacterium named *Fusobacterium necrophorum*, which is more commonly known for causing footrot in cattle. *F. necrophorum* is a so-called "opportunist" that normally lives in cattle's gut. (It also survives very well in the manure; it is found anywhere that manure is found.) However, *F. necrophorum* can only survive in anaerobic environments (where no oxygen is present), such as under the skin. The germ is usually harmless to cattle because it is unable to break through mucosal surfaces or the skin on its own, and thus is powerless to cause an infection. It soon dies on the surface of the skin. When the skin is broken or cut by some other factor, the bacteria take their chance--their opportunity--to live inside the skin and cause disease. This explains why we see disease after an injury wherever *F. necrophorum* is present: it causes tissue death and a severe oral infection in calf diphtheria, or it causes severe lameness when the skin between the claws is damaged in footrot.

There are many opportunistic bacteria. These bacteria normally live in or on cattle, such as mycoplasma living in the throat, *Staphylococcus aureus* living on the skin, or *Moraxella bovis* (pinkeye, or infectious bovine keratoconjunctivitis) living near or even in the eye. Under normal circumstances, these bacteria do not cause harm to the animal. They are part of the animal's healthy flora, the complex mixture of bacteria that live on or in the body. Opportunists who are living happily in the gut, for example, minding their own business, may actually be doing the animal a great favour—they provide competition and make that very same section of gut less hospitable to some very nasty disease-causing germ such as *Salmonella* Dublin. Opportunists prevent many cattle diseases using this idea of competition.

Opportunistic bacteria cause disease when they take advantage of a "beneficial" situation in the host that is normally not available. (At least, it's beneficial to the bacteria.) The host in this case is the animal where the bacteria live. For some reason, the host's defenses become compromised and are not as effective as normal, presenting an opportunity for these bacteria to act. The most common examples of such a compromise are when the host has a weakened immune system, experiences changes in the normal flora (the normal population of bacteria that live in a certain place), or has breaches in the skin or mucosal defenses (such as a cut). These three compromises will be discussed further.

Weakened immune system:

When a calf is malnourished for any reason, either because of not getting enough of the right nutrients or just plain not getting enough nutrients, the calf's immune system will be

significantly weakened and it will be unable to fight off bacteria that, in a strong calf, would not cause disease. Another common example is a cow just before she freshens. Cows in late-term pregnancy have suppressed immune systems and thus require lots of health considerations that lots of people have discussed lots of times!

Change in the normal flora:

Severe temperature changes, sudden feed changes (including changes in the amount being fed), or even big changes in hierarchy among penmates can lead to changes in the types and amounts of bacteria that are part of the calf's normal gut flora. This can lead to enterotoxemia, a disease in which an opportunist suddenly undergoes a huge population growth, which in turn stimulates it to produce toxins that are often fatal to the calf. Antibiotic treatment can lead to a shift in the nasal bacterial populations. Sometimes antibiotics kill off one type of bacteria, which reduces the competition for an opportunist living in the nasal cavity. This opportunist is suddenly able to grow without its normal growth restrictions, and resulting huge growth of this bacteria leads to disease in the calf.

Breaches in the skin or mucosal defenses:

This is self-explanatory. An animal gets some kind of a wound, opportunistic germs that were living on the nearby skin get into the wound, and the resulting infection leads to all manner of disease. Perhaps this is merely a local skin infection, but sometimes it's a whole-body, systemic disease with, for example, the calf being down and extremely lethargic, looking like it's about to die in the next few hours.

And this brings us back to calf diphtheria. *F. necrophorum* gets into the anaerobic environment under the mucosal surfaces and causes a disease inside the calf's mouth... if that mucosal surface was already broken open. There's a range of responses in the calf's body, based on how bad the infection is.

Very young calves, under three months of age, often get the oral form of calf diphtheria. The bacteria stay inside the mouth and do not live deeper in the throat. A wet, painful cough may be noticed. The sick calf usually stands with its head and neck outstretched and gasps noisily. A day later the calf usually shows a high fever (106° F) and acts lethargic, like a pneumonia calf. If untreated, the calf will die in about half a week. Sometimes the immediate cause of death is aspiration pneumonia—the calf found swallowing so painful that it didn't swallow properly, and food material ended up in the lungs instead of the stomach. Other times the calf can't swallow at all, and dies of starvation.

Oral calf diphtheria is generally very treatable with oxytetracycline or penicillin along with an NSAID (fever reducer and pain reliever).

In older calves, the oral form may not be as dramatic but the infection goes from the mouth back to the larynx. This is called the laryngeal form of calf diphtheria. *F. necrophorum* can lead to a permanent deformation of the vocal cords in the larynx and, if so, the calf ends up as a "roarer" for the rest of its life.

Laryngeal calf diphtheria (and roarers) are more difficult to treat. Three approaches are used at the same time: 1) a broad spectrum antibiotic with proven effectiveness, 2) a long-lasting NSAID, and 3) a corticosteroid and/or a diuretic. Not all roarers will recover; a low percentage will die with a few days from pneumonia complications, while a higher percentage will be lifetime roarers and always have difficulty breathing. Calf diphtheria problems (including roarers) are great conversation starters with your herd vet!

How to prevent calf diphtheria? We ask the same question as we ask regarding footrot prevention. What caused the broken or cut skin that allows *Fusobacterium necrophorum* to invade the tissues and cause such damage? Teeth eruption, aggressive tube feeder handling, rough feed, other types of pneumonia in the throat at the same time, or any other cause of cuts inside the mouth, can all give calf diphtheria the opportunity it needs to cause an infection.