Anaplasmosis: Coming to a Farm Near You?

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Abstract

Bovine anaplasmosis is an infectious, noncontagious rickettsial disease characterized by a progressive hemolytic anemia, weight loss, decreased milk production, abortions, and death. This disease is found in many parts of the United States, including Alabama, and causes significant economic losses to the cattle industry. Anaplasmosis is a growing threat to the cattle industry as cattle and the disease move throughout the United States. This lecture will begin with a discussion on the pathophysiology of anaplasmosis followed by diagnosis, treatment, and control and prevention strategies.

Keywords: Anaplasmosis, cattle, diagnosis, treatment, prevention

Pathophysiology

In the United States, anaplasmosis is caused by *Anaplasma marginale*. *A. marginale* is a gram negative rickettsial bacteria. There are two forms of the bacteria: one form being intracellular and the other form surviving outside on the red blood cell. It is this extracellular form that allows the bacteria to infect other red blood cells or to be transmitted transplacentally to the fetus. All ages of cattle can become infected with *A. marginale*. While it is true that younger animals are more refractory to infection, all ages of cattle can become infected. The average incubation period is around 28 days but can range from seven to 60 days. The incubation period range is dependent upon the age of the animal, the immune status or health of the animal, the strain of the organism, and the infective dose. Larger infective doses tend to lead to a shorter incubation period before the onset of clinical signs in the animal. Once an animal is infected, there is a very quick increase in the concentration of bacteria in the blood (up to 1 billion organisms/mL of blood). Once infected at this level, the immune system responds by producing IgG, interleukin, and interferon to reduce the level of infection to very low levels (100 organisms/mL of blood). In order to evade the host immune response, the bacteria can change their outer surface proteins to produce mutant variants. The production of these mutant variants and their ability to evade the immune system leads to an increase in the number of organisms (1 million organisms/mL). The immune system will once again reduce the level of organisms to a low concentration in the blood. Once an animal is infected, they will be persistently infected and show these fluctuations in organism concentrations for the rest of their life. Cattle are persistently infected because *A. marginale* does not produce an endotoxin for the immune system to recognize and because the organism manipulates the host neutrophils and can change their outer surface proteins to evade the immune system and suppress an immune response. The fluctuations in organism

concentration typically occur about every five weeks but can be as short as 10 to 14 days. Because of these fluctuations in the blood concentration of organisms, it is possible that a carrier animal with a very low concentration of organisms may test positive on cELISA (which detects antibodies) and test negative on PCR (which detects the organism). The antibody levels stay constant in these carrier animals despite fluctuations in blood concentrations of the organism.

As previously mentioned, all ages of animals can become infected. Once they are infected, they are considered to be infected for life as they are unable to clear the infection. One benefit of this is that that lifelong carriers will not likely experience clinical anaplasmosis in the future. Whether the animal is treated or not, if the animal survives in initial acute infection, they will be carriers and typically resistant to clinical signs later in life. However, there are some animals that will exhibit clinical signs near calving or during another stressful event which leads to a weakened immune response.

Transmission

There are three means of transmission for *Anaplasma marginale.* The first and most common means of transmission is by biological transmission. This biological transmission occurs by ticks which are the primary vector. Four ticks within the *Dermacentor* genus care capable of transmitting anaplasmosis in the United States, but not all ticks in the United States can carry *A. marginale*. For most of the United States, the American Dog Tick is the most common species to transmit *A. marginale* to cattle. Male ticks are the primary vectors because they are intermittent feeders. The female attaches, feeds, gets inseminated, and then drops off to attach onto another animal. The ticks serve as amplifiers by feeding on a positive animal. The bacteria establish

within the tick by reproducing in the hind gut and salivary glands to reach very high concentrations. The second means of transmission is mechanical which primarily involves the horse, stable, and deer flies. Flies do not amplify the organism like ticks. *A. marginale* can survive in flies for 3 minutes to 2 hours which allows plenty of time for the fly to mechanically transmit the bacteria from one animal to the next. Fomites also serve as a means for mechanical transmission of this organism. Needles are a very effective means of transmitting this disease. Palpation sleeves and rectal ultrasound probes have been shown to transmit viruses and also may be capable of transmitting *A. marginale.* In one study, researchers injected a negative animal (n = 10) with the same needle after using the needle on a positive animal (low level of infection, <2% of RBCs infected) without changing or cleaning the needle. Of the 10 negative animals injected following injection of the positive animals, 6 animals became positive for anaplasmosis. Based on this study, there would be a 60% chance of infecting a negative animal if the same needle was used on a positive animal that was in the chute before the negative animal. Transplacental transfer is another means of transmitting anaplasmosis with 11 to 17% of carrier animals able to transmit it to their calves in utero. These calves are born positive to *A. marginale.*

Mule deer may play a small role as a reservoir for the disease. Occasionally, there are outbreaks of anaplasmosis in bison. White tail deer are difficult to infect, even experimentally, and thus are not thought to play a major role in the transmission of anaplasmosis. Although black tail deer on the west coast can carry the pathogen, cattle serve as the primary reservoir for this disease rather than wildlife.

Clinical Signs

In cattle older than two years of age, the primary clinical sign that producers notice is death of an adult animal. This typically occurs in late summer or early fall but can occur throughout the year. Anaplasmosis causes a progressive, hemolytic anemia that can lead to weight loss or poor weight gain, loss of milk production, and abortions. Younger animals may become infected but not exhibit clinical signs, and they may not experience the anemia seen in older animals. This may be due to younger animals' ability to produce an interferon and interleukin response (which are very important for controlling anaplasmosis) more quickly than older animals. Maternal antibodies may also help protect calves from anaplasmosis, as well. In addition, the bone marrow of younger animals can produce RBCs faster than older animals.

Diagnosis

A very practical method of diagnosing anaplasmosis when clinical signs are present is identification of the organism on a blood smear. A blood smear has good sensitivity when clinical signs are present, but that sensitivity falls (20 to 30%) if used before clinical signs are present. Persistently infected or carrier animals have a low sensitivity for use of the blood smear due to low levels of the organism being present. The cELISA is a serum antibody test and is best used 30 days after infection to allow for seroconversion. In carrier animals, the sensitivity and specificity are very high. Therefore, the cELISA is a good test to identify carrier animals in the herd if they have had time to seroconvert. PCR is an antigen test that identifies bacterial ribosomal RNA. This PCR test will be positive for both *A. marginale* and *A. phagocytophilium. A. phagocytophilium* is a white blood cell *Anaplasma* organism that does not cause disease in cattle in the United States (but does in Europe). *A. phagocytophilium* is carried by dogs, cats, tortoises and other species and is the causative organism of human granulocytic anaplasmosis.

Whole blood and fresh spleen samples are the samples that are used for PCR. It is important to remember that carrier animals with low levels of infection may not be PCR positive. Therefore, cELISA may be the better test when trying to identify carrier animals.

Treatment

When cattle suffer with clinical signs of anemia, a whole blood transfusion may be necessary. It is important that these animals be handled in a low stress environment and receive supportive care. Injectable oxytetracycline has been utilized as part of a chemosterilization protocol in clinical cases. However, it has been reported that some clinically affected animals may not respond to this treatment immediately after clinical disease. Some believe that the immune system must be primed in order to work in concert with the antimicrobial to chemosterilize the animal.

For herds with high genetic potential, there are reports of clearance of the carrier status using injectable, long-acting oxytetracycline and/or oral chlortetracycline. Injectable, long-acting oxytetracycline should be administered at 22 mg/kg subcutaneously once weekly for 8 weeks. Injectable oxytetracycline can cause painful injection site lesions which may make the cattle more difficult to treat over the course of 8 weeks. Previously, oral chlortetracycline was used to treat anaplasmosis. However, the treatment dose of oral chlortetracycline required to treat anaplasmosis is off label and is illegal to use.

Managing Positive Herds

One goal for anaplasmosis positive herds in endemic areas is to become endemically stable. A herd that is endemically stable is a positive herd that rarely has signs of clinical disease. This occurs if a high percentage of the herd can be infected each year. Eventually, the young calves will be infected for the first time. Again, these young, infected calves rarely show clinical signs.

Control and Prevention

While a vaccine for anaplasmosis is available in some states, it is still considered experimental. The vaccine does not prevent infection, but there are anecdotal reports from the field that suggest that it might be able to reduce clinical signs and reduce cow and bull death loss. It is also important to consider that use of the vaccine will make the cELISA ineffective for screening herds for anaplasmosis due to the presence of *Anaplasma* antibodies.

If purchasing new additions to a herd in non-endemic areas, it is important to know the status of the animal prior to arrival on the farm. This could be accomplished by using serology (cELISA) to detect the presence of *Anaplasma* antibodies. An animal that is positive on cELISA should then be tested via PCR to make sure that the animal is truly positive. It is also important to note that some carrier animals with low levels of organism in their blood may test negative on PCR. Another method to *prevent* anaplasmosis is to administer chlortetracycline orally in the feed or mineral (0.5 mg/lb). Oral administration of chlortetracycline in the feed requires a veterinary feed directive from the veterinarian. This is often used in herds that have had a case of clinical disease that had a low prevalence of carrier animals which have undergone chemosterilization. In endemic areas, it may be more beneficial for the herd to become endemically stable, as previously mentioned, rather than attempt chemosterilization.

References

Available upon request.