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Bovine Viral Diarrhea (BVD)¹

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The bovine viral diarrhea virus (BVDV) is a widespread problem for beef and dairy herds. BVDV can readily cross into other species, such as sheep, goats, deer, antelope and bison. However, I will confine my remarks to BVDV in cattle. I will further shorten the discussion by referring to the virus and the disease(s) it causes as bovine viral diarrhea (BVD)

Bovine viral diarrhea is a complicated disease to discuss. When BVD was first diagnosed and reported, textbook authors only addressed the most severe form of the disease. In reality, perhaps only 5% of the animals that become infected with the BVD virus develop clinical signs actually attributed to the virus. Furthermore, only about 8% of those clinical cases would fit the original textbook description of BVD, leaving 92% of the clinical BVD cases undescribed. In addition to the 92% clinical cases that were not described, the 95% of BVD-infected cattle that show no signs actually attributed to the virus were also not discussed. By no means are these statements intended to detract from the importance of BVD as a disease. BVD can be one of the most devastating diseases cattle encounter and one of the hardest to get rid of when it attacks a herd. The problem is, whenever producers look up the classic symptoms of BVD, they read about the most severe form of the disease and

decide that they do not have the problem in their herd.

The severe form of BVD is not the typical form of BVD that most producers encounter.

The BVD virus is an RNA virus that has the ability to replicate into many different variants. If the virus finds itself in a stressful environment or situation, another variant can readily be formed that can dominate the BVD virus population. These variants can result in changes in the virus's disease-causing capabilities.

The family of BVD viruses has recently been grouped into two genotypes, Type 1 and Type 2, and each of the genotypes has been divided into two biotypes, cytopathic (CP) and non-cytopathic (NCP). The distinction between the two biotypes, CP and NCP, is determined solely by how they behave in cell cultures in the laboratory; the CP-BVD virus will damage cell cultures (cytopathic) and the NCP-BVD virus will not (non-cytopathic). The basic difference between the Type 1 and Type 2 genotype BVD viruses is how severe a disease each causes in cattle. The Type 2 BVD virus has been responsible for the more severe outbreaks of the disease within the last few years. Both genotypes (Type 1 and Type 2) have been around for a long time. New diagnostic tests have enabled the laboratories to differentiate between

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1. This document is VM121, one of a series of the Veterinary Medicine-Physiological Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date December 10, 2004. Visit the EDIS Web Site at <http://edis.ifas.ufl.edu>.
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the two. The disease syndromes caused by two different genotypes are basically the same, but the severity of the diseases caused by each is different. The various disease syndromes noted in cattle infected with BVD virus are mainly attributed to the age of the animal when it became infected and the virus biotype (CP or NCP).

The BVD virus manifests in several different ways in the bodies of cattle, which can complicate the disease and make diagnosis difficult. The NCP-BVD virus can infect an animal and remain in the animal as long as the animal lives. It does not stimulate a detectable antibody titer in the animal and can easily be passed to the fetus during pregnancy. In turn, the infected fetus is born, remains infected with the NCP-BVD virus, and, as an adult, transmits the virus to its own fetus. This is generally referred to as being *persistently infected* with NCP-BVD virus. Another complication is that, because of the lack of protective antibodies when persistently infected with NCP-BVD virus, the animal can become infected with CP-BVD virus. In other words, one BVD biotype infection is superimposed upon another BVD biotype infection. Finally, both NCP-BVD and CP-BVD viruses have the ability to suppress an animal's immune system: the viruses lower the animal's resistance to all diseases. With these properties of the BVD virus in mind, we will discuss the different forms of BVD infections.

Subclinical BVD Infections

Approximately 95% of the animals that become infected with the BVD virus do not develop signs of disease that are directly caused by the virus, however, the BVD infection causes the animal's resistance to other infections to be reduced. This reduction in resistance quite often falls to below the threshold of a secondary disease challenge and sickness results. The clinical signs in these cases would depend upon the nature of the secondary infection. These infections quite often are not recognized as being initiated by the BVD virus. For example, when the BVD virus infects the lungs of calves, the virus causes little or no disease. However, the virus interferes with the ability of the lungs to rid themselves of bacteria that are found routinely in the respiratory tract. The bacteria can then begin to

multiply in the lungs and eventually reach a disease threshold. *Mannheimia haemolytica* (formerly known as *Pasteurella haemolytica*) is one bacterium that does this; the secondary infection results in typical "shipping fever." The BVD virus has been identified as one of the most significant disease organisms involved with respiratory disease of cattle. Both NCP and CP-BVD biotypes are associated with subclinical BVD infections.

Peracute BVD Disease

This disease syndrome is usually associated with the Type 2 NCP-BVD virus infection. The affected animals will exhibit high fevers (107°-110°F), occasional diarrhea, respiratory disease, and loss of appetite or anorexia. Peracute BVD can affect cattle of all ages and often results in the death of the animal within 48 hours of the onset of disease regardless of the animal's age

Acute BVD Disease

The classic, acute form of BVD can be caused by either NCP or NCP-BVD viruses and is characterized by a fever of 104°-106°F, a yellow discharge from the nose and eyes, erosions of the muzzle and in the mouth, and diarrhea that may contain mucus and blood. The clinical picture can vary from animal to animal, especially as it relates to the presence of erosions and diarrhea. Diarrhea is usually present in every herd that has an outbreak of acute BVD, but diarrhea is not present in every animal that has acute BVD. Usually an antibody titer is readily detectable following the acute form of BVD caused by a CP-BVD virus. The percentage of the herd exhibiting clinical disease and dying can vary extremely; however, if secondary infections are controlled, most animals survive the acute disease. Acute BVD infections in the newborn calf may be more prevalent than is currently recognized because the disease is usually masked by secondary infections that cause diarrhea and/or pneumonia.

Chronic BVD Disease

The chronic form of BVD is associated with prolonged BVD virus infections and very poor or absent antibody titer to the BVD virus. The clinical signs associated with the chronic disease are similar

but more extensive and severe than the clinical signs associated with the acute BVD disease. The chronically diseased animals exhibit depression; a lack of appetite; a lingering diarrhea; a yellowish discharge from the eyes and nose; crusted muzzle; erosions of the mouth; bald spots due to loss of hair; and lameness due to inflammation of the hair line, sensitive laminae, and the tissue between the claws of the feet. The chronically infected animals usually appear unthrifty and starving. Death occurs more frequently in chronic BVD infections than in acute BVD infections.

Mucosal BVD Disease

An animal persistently infected with NCP-BVD virus is not able to elicit any defense against becoming subsequently infected with the CP-BVD virus. When a CP-BVD infection is superimposed onto a NCP-BVD infected animal, mucosal BVD disease can result. The clinical signs of mucosal BVD disease are similar to but even more severe than those associated with the chronic form of BVD. The erosions extend from the muzzle, through the gut, and out the rear. The erosions are found on the mucosal surfaces throughout the gut; hence, the term *mucosal* disease. The cattle look like "death warmed over." There is little chance of survival for these animals.

Fetal BVD Disease (BVD Infection of the Unborn Calf)

The results of a fetal infection with the BVD virus are usually determined by the age of the fetus at the time of infection. The BVD virus is capable of passing easily *in utero* from an infected cow to the fetus, which is particularly vulnerable to the BVD virus during the first 6 months of pregnancy. Death of the fetus is common if the infection occurs during the first 120 days of pregnancy. Resorption, mummification, or abortion of the dead fetus will result. However, a CP-BVD virus in a cow can revert into a NCP-BVD virus as it infects her fetus under 120 days of age. Fetuses that survive the early infection will be born without a detectable antibody titer and be persistently infected with the NCP-BVD virus. The early-age fetus (under 120 days of age) possesses an underdeveloped immune system and does not recognize the BVD virus as foreign; thus, the

fetus does not mount an immune response against the BVD virus. Hence, the fetus remains infected with NCP-BVD virus and does not have a detectable anti-BVD titer. It is also not uncommon for the surviving fetus to be malformed or blind, or to have skeletal defects. Underdeveloped brains are common defects also noted in such calves. You may also get a normal appearing, persistently NCP-BVD-infected calf that may be weak at birth, grow poorly, be susceptible to respiratory diseases, and die before it can be weaned. They may also grow normally, reach breeding age, and produce more persistently NCP-BVD-infected calves (the virus is passed from generation to generation). Persistently infected (PI) carriers can only be created by *in utero* infection with a NCP-BVD virus during the first 110-120 days of pregnancy. If the fetus becomes infected after 120 days of pregnancy, there may be an abortion, but usually because a fetus of this age has a more developed immune system and can present an immune response against the BVD virus, a healthy calf is born that has a good level of BVD antibody titer.

Persistently infected (PI) calves never clear the BVD viral infection and repeatedly shed the virus to other cattle. The appearance of a PI calf can vary widely. The calf might look completely normal, or it might appear to be on the point of death from mucosal disease. We typically think of the PI calf as one that has a dull hair coat or one that is small and unthrifty looking. Normally, PI cattle have decreased survivorship, but not always. The dangerous ones are the ones that look good enough to be kept as herd replacements. The PI animal that is retained in the herd serves as a reservoir for the BVD virus. There are several tests to identify persistently infected animals. If you suspect a BVD problem, work with a knowledgeable veterinarian to develop a workable plan to handle the situation.

Infected cattle are considered to be the principle reservoirs of BVD virus; however, other ruminants including deer, antelope and buffalo are also known to become infected with BVD virus. The virus is shed from cattle in the feces and in secretions from the nose and mouth. Fecal contamination of food and water sources is a very important means of transmission; BVD is also readily transmitted by

aerosol droplets and direct contact. Studies have also indicated that the BVD virus can be transmitted from infected animals to susceptible animals during rectal examinations when the operator does not change gloves.

Treatment, Prevention and Control of BVD

There is no effective treatment that can alter the course of BVD infections, but most BVD virus infections are subclinical and self-limiting. If treatment is initiated, antibiotics, B vitamins, and fluids may be used in attempts to control secondary infections and provide supportive therapy. Changes in feed rations to enhance the palatability of the feed could tempt the sick animal to eat needed nutrients.

Vaccination of susceptible cattle has been the principal approach to the prevention and control of BVD. Presently, there are two forms of BVD vaccine:

Replicating BVD Vaccine

Modified Live Virus (MLV) Vaccine - usually requires only one injection to stimulate long protection. Modified live BVD vaccines should not be administered to pregnant cattle during any stage of pregnancy. If the cattle are in the first 120 days of pregnancy, the fetus may become infected with the vaccine virus and be aborted, be born weak, or be born in apparent good health but be persistently infected. Such calves never develop a measurable antibody titer and can be a lifetime shedder of the virus. If later exposed to a different BVD virus, they may develop mucosal BVD disease and die. If cattle are in the last half of pregnancy when vaccinated with a MLV, the fetus may become infected, die and be aborted.

Most MLV-BVD vaccines can be administered to calves nursing pregnant cows. The MLV-BVD vaccine virus is non-shedding and should not be transmitted to the pregnant cow. Read the label! The misunderstanding about the vaccine's use in calves nursing pregnant cows is due to combination vaccines. Most MLV BVD vaccines are in combination with a replicating MLV IBR vaccine. Replicating MLV IBR vaccines should not be used in

calves nursing pregnant cows; the IBR virus may shed from the calves to the cows and cause abortion. However, young calves that nurse BVD-vaccinated cows will possess maternal antibodies that can neutralize the MLV-BVD vaccine administered to the calves. Hence, most labels on MLV-BVD vaccine advise users that *animals vaccinated before 6 months of age should be revaccinated at 6 months of age.*

Non-Replicating BVD Vaccine

Killed Virus vaccines are safe to use in all cattle regardless of the pregnancy status. It requires two doses of killed virus vaccine to initiate a high level of resistance. It also requires that the animal receive a minimum of one annual booster to maintain a significant level of resistance.

There has been a lot of discussion about MLV-BVD vaccines causing problems in cattle, especially newly arrived feedlot cattle. Remember, if the animal has already been exposed and is incubating the BVD disease virus, vaccination will not alter the disease course. You could vaccinate an animal incubating the disease and when it broke with BVD, the vaccine would be erroneously blamed. Some researchers have suggested that if a persistently BVD-infected animal was vaccinated with a MLV-BVD vaccine, the animal could come down with the mucosal form of BVD. What they fail to say is "essentially there is no way to adequately protect a persistently BVD-infected animal in a BVD-infected herd." Detection of the persistently infected animals requires special virus identification tests that are available to be run at several diagnostic laboratories in the U.S. Vaccines do not protect infected animals; vaccines aid in the prevention of infection.

Most outbreaks of BVD have occurred in herds with a history of no or inadequate BVD vaccination. A single initial dose of a killed BVD vaccine is inadequate even if boosted annually; the second dose of the initial vaccination protocol must be administered for adequate vaccination to occur. While adequate vaccination appears to protect the cow from severe disease, it may not always protect the fetus. Most current vaccines contain Type 1 BVD virus, but there appears to be some cross-protection against Type 2 BVD virus, at least for a short period. If your herd is at risk of developing BVD, then it

would be advisable to make sure the herd is adequately vaccinated. We now have BVD vaccines which contain both Type 1 and Type 2 BVD antigens.

If the herd in question consists of pregnant animals, you must use a killed form of the vaccine. If you suspect a Type 2 BVD challenge, then it would be advisable to use a killed vaccine containing Type 1 and Type 2 viruses, or to administer booster vaccines at three-month intervals with different killed-BVD vaccines (switch companies every three months).

If the animals are not pregnant you could use a MLV-BVD vaccine. There also appears to be more cross protection against Type 2 BVD viruses when using MLV-BVD vaccine than when using the killed forms. Several manufacturers have provided the industry with MLV-BVD vaccines containing both Type 1 and 2 BVD viruses.

To control and prevent BVD infections, it is important to establish an immune population before a disease appears. A few basic principles can provide a framework on which to build a BVD vaccination program:

1. Initiate vaccination of calves after 4-6 months of age to avoid interference from maternal antibodies passed to the calf during colostrum feeding. When using killed BVD vaccine, re-vaccination in 30-60 days will be required to stimulate an adequate level of protection. The BVD vaccinations should be completed in the calves at least 30 days before weaning.
2. Properly vaccinate all unvaccinated heifers and cows before breeding to ensure protection for the fetus.
3. Properly vaccinate all bulls before putting them out with the cows or heifers.
4. Properly vaccinate all new additions before adding them to the herd.
5. When using killed BVD vaccine, annual boosters are required to maintain an adequate resistance level when dealing with Type 1 BVD. If dealing with Type 2 BVD, vaccinate using a killed BVD vaccine containing Type 1 and Type 2 viruses or booster at three month intervals using different company products. Breeding stock should be

booster vaccinated immediately before the breeding season to provide maximum protection to the fetus. Even if MLV-BVD vaccine was used as the initial vaccination agent, a booster vaccination using either MLV or killed BVD vaccine is recommended every few years. Remember, do not booster vaccinate pregnant cows with replicating BVD vaccine.

Even the best vaccines cannot always overcome poor health, poor immune status, poor timing of vaccine administration, overwhelming disease challenge, or virus strains divergent from the one the animal has been vaccinated with.

Dr. Kenny Brock at Auburn University has initiated the Top 10 List to prevent BVD in a herd. It is as follows:

1. Maintain a strict level of herd biosecurity.
2. Purchase only open animals that are known to be BVD-negative before purchase.
3. Isolate any new additions or animals re-entering the herd for a minimum of 30 days.
4. Test any new additions for BVD, and vaccinate during the isolation period.
5. Maintain good sanitation and routinely disinfect contaminated areas. Prevent contamination from outside sources by disinfection.
6. Prevent contact with neighboring cattle of unknown status.
7. Protect pregnant animals from potential sources of exposure during the first trimester.
8. Prevent mixing of animal groups immediately before breeding and during the first trimester.
9. Conduct surveillance for BVD by performing necropsy on dead animals and collect blood samples on any calves that are poor-doers and calves that have respiratory disease.
10. Vaccinate the cow herd yearly. Ensure that heifers are properly vaccinated at 6 months of age (two doses) and are booster vaccinated before breeding.