BVD Vaccines — Is There An Answer

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Problems associated with bovine viral diarrhea virus (BVD) infections seem to be increasing in the United States. I get many questions from veterinarians and investigate more and more BVD infected herds. Most of these herds do not exhibit any outward clinical signs of BVD infection but reproductive problems or underlying immune suppression are often seen.

Why are BVD problems on the rise?

There are probably several reasons. One has to do with our ability to better diagnose these infections in the laboratory, particularly the noncytopathic strains. In addition more samples are being submitted for testing. These samples include whole herd testing to find persistently-infected animals. Last, we are seeing an increase in the number of persistently-infected cattle on farms in the United States, probably due to strain variation, the virus's ability to mutate and correspondingly shortened durations of immunity.(1)

In order to understand the increase in infected herds it is necessary to review noncytopathic and cytopathic BVD. There are many different strains of BVD. These can be differentiated using monoclonal antibodies and then grouped into families based on common antigens.(2) All BVD strains are divided into cytopathic (CP) and noncytopathic (NCP) strains. It appears that some of these strains have the ability to mutate from NCP to CP.

Cytopathic versus Noncytopathic Strains

The CP/NCP differentiation is solely laboratory determined. When a CP strain is grown on a cell culture, the virus kills the cells, whereas a NCP strain does not. The NCP/CP designation does not relate to the virulence of the strain. Some of our most virulent strains in vivo at this time are NCP in vitro.(3) Clinically you can't tell whether a NCP or CP strain is going through a herd.

The difference is still important, however, because of what it may indicate in the herd. The CP and NCP strains react most differently in the non-immune pregnant cow. If a nonimmune cow is exposed to a NCP strain while in the first trimester of gestation, early embryonic death, abortion, mummification or persistently-infected calves can result. If exposure occurs during the second trimester, birth defects, primarily involving nervous tissue, or occasionally persistent infection, are found. Infection during the last trimester usually has no effect on the fetus and the calf will be born with antibodies against BVD. Rarely, there is an overwhelming exposure which causes a late abortion.(4)

What does persistent infection mean?

When BVD infection occurs before the immune system has fully developed, the calf learns to recognize the virus as part of itself and never mounts an immune response against that particular strain of BVD virus. Persistently-infected calves can be born normal and constantly shed the virus or they can be born weak and die.

Persistently-infected calves that appear normal can reach adulthood, breed and have persistently-infected calves. They are also a constant source of viral shedding to the rest of herd. The current persistent infection rate in the United States among cattle under one year of age, is estimated at 1 1/2 - 2%. This is similar to the death loss from mucosal disease seen in many feedlots. In some herds, 10-50% of the calves may be carriers. In cow-calf and dairy operations reproductive failure is often the only sign of BVD exposure. Once an animal is persistently infected, nothing can eliminate the virus or stop its shed.

Vaccination and Infection

Confusion exists regarding vaccination programs because of the increasing number of BVD problem-herds being diagnosed. Some of these herds have been on a killed BVD vaccination program, but have still seen a slow increase is reproductive problems over a two to three year period.

Our knowledge about ability of the different vaccines to protect against BVD infection is increasing rapidly. Recent studies have shown that the duration of immunity afforded by the killed vaccines is dependent on the antigenic similarity between the vaccine strain and the wild type virus to which the cow is exposed: if there are few common proteins, this protection can be as short as four months; if there are many common antigenic sites, it may last a year.(1,5) Unfortunately, many persistently-infected cows have strains that are antigenically distant to our vaccine strains. Thus, these cows are a constant source of infection against which herd mates, if vaccinated with a killed vaccine annually, have little protection.

The same holes in protection are found with modified live virus (MLV) vaccines but they do not become apparent until 11-12 months after vaccination, closer to the time of annual revaccination and past the time when the virus can cause problems in early pregnancy.(6)

Given these limitations, what are our options for vaccinations?

These limitations primarily affect the cow-calf and dairy practitioners; the majority of feedlot veterinarians already use MLV BVD vaccines and the shortcomings are seen if exposure occurs during pregnancy. If you have an open herd or a herd that has had diagnosed BVD problems, you have two options to maximize protection:

1. Increase the frequency of vaccination with the killed vaccines to three times a year. Rotation is probably not necessary with this vaccination schedule.
2. Give a MLV BVD vaccine to the open cow three weeks before breeding or turning in the bull.

If killed vaccines are only to be given annually, vaccines containing to multiple strains will provide broader protection.(7) This protection may still be of insufficient duration to protect against reproductive problems.

Vaccination and Mucosal Disease

Mucosal disease is seen when an animal that is persistently-infected is exposed to another closely related cytopathic strain of BVD.(8) Theoretically, an animal can also have a spontaneous mutation of the noncytopathic BVD strain involved to a cytopathic strain, thereby causing mucosal disease without any subsequent exposure. High stress and immune depression may be involved in this reversion.

One of the major concerns of using MLV vaccines is whether they have the ability to cause mucosal disease. I have never seen this in all the doses I have used in dairy animals. Many of you are also using them without difficulty. Dr. Bolin tried and failed to cause mucosal disease in persistently infected calves by vaccinating with MLV BVD vaccines(9). It appears that in order for mucosal disease to occur, the CP strain in the MLV vaccine must be closely related to the NCP strain in the persistently-infected animal. With the degree of attenuation of the MLV vaccines today, a second set of circumstances is needed. The second predisposing factor is the background of the animal being vaccinated. If the animal is nutritionally-deficient, persistently-infected and severely stressed, the likelihood of inducing mucosal disease with vaccine may be higher. All of this doesn't mean that the MLV vaccines can't cause mucosal disease, but it does suggest that specific set of circumstances is required and that disease production, if it occurs, is rare.

You do have options when it comes to BVD vaccination, and you need to realize the limitations of each approach. If a quick and accurate test for BVD is devised,

we may be able to start an eradication program. In a small herd,a program of virus isolation, culling and annual vaccination is an attractive option for handling BVD problems. In large herds, the cost of testing may be prohibitive. In such cases, we must assume carriers are present and vaccinate accordingly.

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SUMMARY:

Bovine viral diarrhea virus infection is being diagnosed with increasing frequency. The number of herds containing persistently-infected carriers is also on the rise. Recent research has shown that killed bovine virus diarrhea vaccines have a duration of immunity as short as four months following vaccination. This may partly account for the increase in infected herds. In order to maximize protection against bovine viral diarrhea virus killed vaccines must be given three times a year or a modified-live bovine virus diarrhea vaccine can be given annually to nonpregnant cattle.