UNDERSTANDING BVD REPRODUCTIVE DISEASE

Lynn Woodard, DVM, PhD
Hana Van Campen, DVM, PhD

The various disease syndromes caused by the bovine viral diarrhea virus (BVDV) are complex and vary from mild clinical disease to sudden death to reproductive failure. This wide variety of disease problems make it difficult for the beef producer to grasp all the problems attributable to BVDV. Furthermore, because of the wide variety of disease syndromes that can occur, the virus is often blamed for many disease problems without diagnostic evidence that it is actually the culprit.

"Bovine viral diarrhea" is a misnomer for most of the disease problems seen with BVDV because diarrhea is often not seen. The main effects of viral infection in the U.S. today are associated with respiratory disease outbreaks in feeder animals and reproductive disease in pregnant cows, although sudden death in cattle of all ages have been seen. BVDV is perhaps the single most important infectious disease agent in the beef industry. This article deals with the reproductive effects of BVDV infection in the fetus.

CHALLENGING PROPERTIES OF THE VIRUS

1. Mutations. The virus has mutated into dozens of strains that can infect a variety of organ systems ranging from the digestive tract to the respiratory tract to the reproductive tract plus many other organs. It will continue to mutate.

2. Persistently-infected (PI) carrier animals. The BVDV can cause *in utero* infections that result in the fetus being infected permanently. When born, these PI animals shed large numbers of virus and are often the primary source of BVD disease in beef herds; exposure to infected animals from outside the herd is not required. The origin of PI animals will be examined in-depth in this article.

3. Immune Suppression. The virus infects many cells of the immune system and impairs the animal's ability to ward off other disease agents. So, while the BVDV may not kill an animal directly, the immunosuppression allows other infectious disease agents to do serious injury or cause death.

TERMS

The producer is under a constant barrage of terms relating to BVD disease problems. Among those, cytopathic vs. noncytopathic strains and type 1 vs. type 2 strains are in common usage. A brief look at the meaning of these terms is in order.

> **Cytopathic vs. Noncytopathic strains.** This is strictly a laboratory finding and means that the particular virus strain being cultured has the ability to kill (cytopathic or CP) or not kill (noncytopathic or NCP) the tissue culture cells needed to propagate the virus. It has no bearing on whether the strain is capable of killing an animal; indeed, most field isolates are noncytopathic and some of these can kill an animal in hours or days.
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> **Type 1 vs. Type 2 strains.** In 1993, adult dairy cattle were dying suddenly in Canada and parts of the northeastern U.S. Genetic typing found that these BVDV isolates were quite different than the recognized strains in existence. The new mutations were deemed Type 2 strains. Many states now report that Type 2 isolates are more common than Type 1.

Whether a BVDV isolate is CP, NCP, Type 1 or Type 2 does not indicate ability to cause disease and degree of vaccine efficacy. Vaccine companies have jumped on the bandwagon and many are now producing vaccines with both Type 1 and 2 strains. Only time and independent research will determine

their efficacy in disease prevention. Until peer-reviewed scientific research is available, producers should not purchase vaccines based solely on advertising hype. Unlike the FDA which regulates human vaccines and closely monitors advertising claims, the USDA regulates animal vaccines and makes little or no attempt to regulate advertising.

REPRODUCTIVE DISEASE ASSOCIATED WITH BVDV

Disease problems associated with this virus vary greatly depending on the stage of pregnancy when the cow is exposed and her immune status to the virus at the time of exposure. If the dam is immune to the exposing strain, the virus is eliminated and no infection occurs in the fetus. However, if the dam's immunity is insufficient to prevent fetal infection by a particular strain or if she happens to be persistently infected with the virus, then several things can happen.

1. First 4 Months of Pregnancy

A. Early embryonic death. If the developing embryo is infected and killed, an "infertility" problem may occur with cows coming back into estrus late in the breeding season. Increased open cows and late calvers may occur. This is one of the least studied aspects of BVDV infection and the extent of the problem is not known. However, we do see herds with diagnosed BVDV problems where an increased number of open cows is noted; generally, these reductions in pregnancy rates are in the 5 to 10% range. More research is needed to identify the true impacts of early embryonic losses.

B. Abortions. With BVDV, abortions can occur at any stage of pregnancy, even months after initial infection. The earlier in the course of gestation these infections occur, the greater the diagnostic challenge. Virus cultures may be negative simply because the virus has done damage but is no longer present for culturing.

C. Stillbirths/Weak Calves. Calves may be delivered full term, either dead or weak.

D. Persistently Infected Calves. Understanding the origin of PI carrier animals within a herd is essential to the producer. They originate in the first 125 days of pregnancy when NCP virus infects the developing fetus. This occurs before the fetal immune system develops. As the fetal immune system does develop, it recognizes everything present as "self" or normal; thus, no attempt is made to reject the "non-self" foreign virus. If the infecting strain doesn't kill the developing fetus, the calf will be born persistently infected and will be immunologically tolerant to that particular strain. No immune rejection attempt occurs. In most semi-closed beef herds, these PI animals will be the primary source of virus. Recent Canadian research has shown that most PI animals are nursing calves. Finding and eliminating PI carriers can be quite a diagnostic challenge to producers and their veterinarians. The fate of PI animals will be discussed later in this article.

2. Mid-Pregnancy

A. Abortions, stillbirths and weak calves can result from BVDV infections at this stage of pregnancy.

B. Congenital defects. Most beef producers have observed calves born with "birth defects" as a result of BVDV but did not know what the cause was. From about 90-150 days of pregnancy, viral infection of developing organ systems can lead to a variety of congenital defects. The brain, eye and skeleton are especially vulnerable. Underdeveloped brains and cleft palates are a couple of examples of congenital defects that may be caused by the virus. Realize that there are many causes of congenital defects and BVDV is only one of the many that have to be considered.

3. Late Pregnancy

After about 150 or so days of gestation, the fetus develops a functioning immune system that can protect the developing fetus from most strains of BVDV. So, most 3rd trimester exposures do not result in fetal infection or death. However, especially "hot"or virulent strains can cause fetal infection or deaths just like they can in calves and adults.

FATE OF PI's

As noted above, most PI's in beef herds will be found in the nursing calves. Because the virus is so immunosuppressive, most will die in early life of scours or pneumonia. However, a few will live for several months or, in rare cases, for several years. In many herds, no adult carriers can be found. This presents quite a diagnostic challenge for producers and veterinarians trying to eradicate carrier animals from a herd, because all nursing calves would have to be tested
before the breeding season to break the transmission cycle.

PI calves that survive to weaning are generally stunted and severely underweight for their age. Only a very few will be average in weight. Testing "runts" and poor-doing calves at weaning time can be useful in diagnosing the presence of BVDV in a given herd. Most PI calves will be from normal cows that lacked immunity to protect them *in utero*. However, the dams of any calves that test positive for the virus should also be tested to make sure that they are not also PI carriers.

A very few PI calves will look normal and be of average weight at weaning. Selection of such animals for replacement bulls or heifers will continuously expose herd mates to infection.

PI's can develop a chronic fatal disease known as mucosal disease. Most researchers now believe that mucosal disease results from a mutation of the persisting strain to a more lethal strain of the virus. These animals develop severe ulceration of the mucosal surface of the entire alimentary tract, from the nose and mouth to the anus. Clinically, they develop severe ulcerations, diarrhea, fever and subsequently die. On rare occasions, modified-live BVD vaccines can induce mucosal disease in PI animals. This is good because another carrier animal has been eliminated.

Note: all calves out of PI dams will be PI's; however, most PI calves will be from non-carrier dams that did not have sufficient immunity to prevent fetal infection.

PREVENTION OF REPRODUCTIVE BVD

Protecting weaner calves and cows from respiratory and sudden death forms of BVD appears to be a much simpler task than protecting fetuses from *in utero* exposure. Both killed (K) and modified-live virus (MLV) vaccines are available and both types of vaccine will confer acute disease protection when given as directed. The killed vaccines require two doses and generally give about 6 months of protection. The MLV vaccines only require one dose and give up to 3 years of protection. There appears to be satisfactory cross-protection between strains and recent research has shown at least one Type 1 vaccine will protect against Type 2 challenge in older calves.

In calves less than about 5 months of age, colostrum antibodies will impair the protective response. Although research has shown that cell-mediated immunity will develop to the IBR and BRS virus fractions of multivalent MLV vaccines given to young calves despite high levels of colostrum antibodies, this has not been shown to occur with the BVD virus fraction.

Because the greatest economic threat to the cow-calf producer is from fetal infections, special consideration must be given to protecting the unborn fetus. Research into fetal protection after vaccination of the dam with BVD vaccines is lacking. With a single exception, none of the current vaccines on the market have shown fetal protection in a peer-reviewed publication. Most older literature indicates that protection is very poor, but most of these trials were lacking in design and numbers. Recently, one Type 1 MLV vaccine was shown to provide about 80% protection against a

Type 1 challenge that infected all the control fetuses. We are awaiting the results of the Type 2 challenge study. The authors are aware of at least one other major company that is testing its vaccines for fetal protection.

The Bottom Line: The USDA has an obligation to producers to strictly enforce all label claims by biological manufacturers. Until then, we urge producers and veterinarians to ignore advertising claims that are not substantiated by published research. Although adding Type 2 strains should broaden protection, published research---- especially regarding fetal protection---- is sorely lacking.

The authors recommend a minimum of two doses of a MLV vaccine be given to replacement heifers with the second dose given about 1 month before breeding. Using two different products with different strains of BVDV may broaden protection. Both antibody and cell-mediated immunity will result from MLV vaccines. ***Developing the immune heifer cannot be over emphasized.*** A yearly booster of MLV vaccine given 3-4 weeks before breeding when cows are open is recommended. Warning: Do not give MLV BVD vaccines to pregnant cows.

TESTING AND ELIMINATION OF PI CARRIERS FROM A HERD

Owners of closed or semi-closed herds experiencing confirmed BVD reproductive problems may wish to work with their veterinarians to attempt elimination of carrier animals. Rapid and economical tests are available from diagnostic laboratories and are now commercially available. These rapid tests go by various names such as BVD microtiter virus isolation or BVDV ELISA. Essentially, serum is used and virus is detected with the use of antibodies that react to all strains. Calves less than 3 months that have received colostrum present a special problem, so culture of unclotted blood is recommended. Whole herd eradication should not be undertaken without full knowledge of the time, cost and pitfalls. Consult with your veterinarian for full details.

Dr. Woodard is the Extension Veterinarian and Dr. Van Campen is the Diagnostic Virologist with the Wyoming State Veterinary Laboratory and Department of Veterinary Sciences at the University of Wyoming.