Being nibbled to death by a duck

Persistently infected BVDV animals on the dairy can contribute to a host of problems; elimination involves a two-step approach.

By Geni Wren

Make no mistake: a bovine viral diarrhea virus (BVDV) infection is about as immunosuppressive as they come. The mildest BVDV strain can destroy 15% of the animal's immune response, and up to 80% of the immune system can be wiped out with more virulent strains. "We usually see the peak of destruction to the immune system between days 6 and 9 post-infection," says Julia Ridpath, PhD, National Animal Disease Center, Ames, Iowa. "We start to see damage at day 3 post-infection."

And considering about every bovine, sometime in its lifetime, will be exposed to BVDV, that can add up to a lot of problems. Ridpath says that BVDV is so common in the industry that in the research community it's almost impossible to find cattle with negative BVDV titers. According to her, 10-15% of herds currently have an active BVDV infection circulating based on the incidence of persistently infected cattle.

Frank Bernard, DVM, Dipl. AVBP (dairy), Port St. Lucie, Fla., says 100% of the herds that he has tested had animals positive for persistent BVDV infection. "I had herds with positive PI animals in the milking herd and dry group," says Bernard. "It is out there." Bernard works with herds from 900 to 8,000 cows.

Adding persistent infection (PI) animals into the mix can cause your producers' bottom line to take a nose-dive more than with just acute infections. Ridpath notes that it's estimated that one PI animal on a dairy with 100 cows or more costs a dairy herd $1.93/cwt. (Joly *et al.*, 2004). Ridpath says there are estimates that low-virulence strains cost U.S. producers on a yearly basis $376 million to $1.5 billion in reproductive costs, $330-$494 million in milk production losses and $360 million in reduced production in feedlots. These estimates are based on the effects of infection with low-virulence strains. Loss estimates would be higher if based on infection with higher-virulence strains. "For example, losses due to the high-virulence strain in the 1995 Canadian outbreak approached $100,000 per herd," she says.

What's so difficult about pinning numbers to it is that "BVDV is like being nibbled to death by a duck," says Ridpath. Higher rates of respiratory disease and mastitis, poor growth and performance of calves, etc., tend to occur when BVDV and PIs are present in a herd. "I think it is because BVDV does so many different things to a herd," she explains. "It is a broad spectrum of adverse effects. Recognizing the effects of BVDV infection would be easier for producers if they would see just one or two definitive signs, but instead what you see is a plethora of effects that reduce performance but don't fit a clear pattern."

Bernard has seen BVDV contribute to problems with reproduction, metritis, infertility, abortion and perinatal loss. However, he notes, BVDV isn't always the sole culprit as other agents, such as IBR, leptospirosis, *Neospora*, *Ureaplasma*, *Mycoplasma* and *Haemophilus*, can cause similar problems.

— PI BVDV on the dairy

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One of the risk areas for BVDV exposure and infection is when heifers enter the breeding or milking string.

He mentions that *Salmonella* infections are more prevalent than ever on large dairies, and "we need to implement the best control measures to fight this killer bug."

Ridpath goes on to explain that the presence of a PI animal in a herd doesn't usually result in a clear "footprint" that allows the producer or veterinarian to say, "Aha, that is obviously BVDV." What you see are a number of interrelated problems that are often chalked up to poor nutrition or genetics.

Bernard agrees. "When you review the herd data from reproduction to health in general, if the herd does not perform in the normal acceptable range, you may have BVDV going on in the herd. Once it is diagnosed in your practice, you have to stay on top of it and consider every herd infected."

To know the extent of BVDV and other potential diseases circulating through the herd, you need to keep track of health and production parameters. Bernard suggests ongoing farm monitoring and evaluating trends. "Basic monitoring is always helpful on a dairy," he says. For example, the number of clinical metritis cases, abortion rate (including days in milk and number of lactation at the abortion incident), reproductive monitoring, such as reproductive culls, projected calving interval, pregnancy rate, conception rate, days to first service, etc., are all important parameters.

"Also, since BVDV causes an immunosuppression, you can have outbreaks of respiratory problems or other health problems, such as mastitis, or even poor milk production," he adds. And, don't forget the youngstock. Bernard says to keep records of stillborn rates and morbidity and mortality rates of the first six months of life. "Make sure to review the treatment rate and response rate in the young animals as well."

PIs are not good 'vaccinators'

One common misunderstanding in the bovine world is that a couple of PIs in the herd can be beneficial in the sense that they "vaccinate" the rest of the herd by constant exposure. This is a dangerous game to play, says Ridpath.

JULIA RIDPATH, PhD

An acute BVDV infection robbed a Jersey calf (above) of growth and development, while its non-challenged cohort developed normally (below).

JULIA RIDPATH, PhD

"Leaving a PI animal in place is not an efficient way of vaccinating a herd. You don't know for sure which animals have been in direct contact with the PI, so you really don't know if everyone has been 'vaccinated' by the PI."

"BVDV causes disease, even when the outcome of that process is economic loss and not always clinically sick cattle," says Jim Rhoades, DVM, Novartis Animal Health. "The objective of any vaccine strategy is to reduce the severity, duration and frequency of disease. Allowing wild virus exposure as a method against disease protection has a large amount of risk that is not warranted."

Ridpath adds that leaving the PI in place is like vaccinating 24/7. "PI animals are pretty much shedding virus all the time," says Ridpath. "In contrast, acute infection with low-virulence BVDV doesn't result in very much shed. While acute infection with a high-virulence virus can result in viral shed that is as high or higher than that seen with PI animals, this shed only lasts for three to 10 days while the PI shed is constant."

Producers are familiar with the drop in weight gain or mild production drops following vaccination. In the presence of a PI, this drop is always in effect. "While the animal mounts an immune response to the virus the PI is shedding the first time it is exposed, it continues to react to the PI virus as it has contact with the PI animal," Ridpath explains. This produces extremely high titers, but repeatedly mounting this immune response costs the animal energy. "The energy used to mount this response takes away from the energy that is available for weight gain or milk production."

Ridpath gives the example of two Jersey calves, one acutely infected with BVDV and one not infected. A BVDV infection during the neonatal time period can "hijack" the immune system and cause the body to send its resources there, to the detriment of muscle, bone and growth development (see Jersey calf photos above).

"We have just made the observation that a severe acute BVDV infection in a neonate results in long-term slow down in growth and poor body condition," says Ridpath. "We are not sure of all the mechanisms involved but are in the midst of several studies that we hope will answer those questions."

The hundreds of BVDV strains in the environment are ever-changing. In fact, Ridpath notes that influenza strains are very stable compared to BVDV strains. That's why it's an erroneous assumption that you don't need to test for and cull PI animals and that all you have to do is vaccinate with modified-live virus (MLV) vaccine to kill off all of the PI animals in the herd. That could happen to some degree, but it won't solve the problem. "MLV vaccination may kill those PIs that are carrying a virus that resembles the vaccine virus," says Ridpath, "however, those PIs carrying a virus that is dissimilar to the PI strain will not go down with mucosal disease and die."

Worst exposure times

Three of the worst times that dairy cattle can be exposed to BVDV are at about 6 months of age when passive immunity wanes, commingling at sale barns and when entering the breeding/milking strings. At these times, cattle can be exposed to new BVDV strains they have not been exposed to before. Having animals well-vaccinated prior to these stressful events where exposure occurs is key. "Immunologists tell us that B-cell responses take five to 14 days to develop and measurable T-cell responses take longer," says Ridpath. "You also want the animal to have recovered from the vaccination physiologically and be back on an even keel.

At the January 2006 "BVD Control: The Future is Now" symposium, Kenny Brock, DVM, MS, PhD, Auburn University, reported that modified-live vaccine produced a protective immune response within five days of vaccination. "However, giving the animal longer than five days will result in a stronger response," says Ridpath. "It would be best to give the immune system at least a two-week 'head start' before you challenge it."

Recent research at South Dakota State University described a white-tailed deer infected with BVDV. "The implications of this could be far-reaching, increasing the importance of a well-planned vaccination program," suggests Rhoades. "This could represent a source of the virus not easily controllable from a biosecurity standpoint."

Twofold approach to eliminate BVDV

For the best chance of eliminating BVDV from the dairy herd, a twofold approach of testing/identifying/culling PIs and a good vaccination program is needed.

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Julia Ridpath, PhD, says PI animals are shedding virus all of the time.

FRANK BERNARD, DVM, Dipl. ABVP

Frank Bernard, DVM, Dipl. ABVP, says testing and identifying PI animals is a good return on investment for dairies.

JIM RHOADES, DVM

The economic loss a single PI animal can produce clearly defines the need to remove it, states Jim Rhoades, DVM.

Biosecurity holes

Today's dairy landscape looks a lot different than even a decade or so ago. Farms are expanding, and dairies are moving into areas that have never seen dairies before. As a result, dairy cattle are shipped coast to coast, whether through direct sale, sale barns or heifer-raising operations. This movement of cattle has also allowed the spread of BVDV across the country.

Some dairies, however, that insist they are still "closed" may still have occasional problems with BVDV or PI animals in the herd, which can be a confounding problem. The first step is to absolutely identify any biosecurity holes where dairy animals on the farm can be exposed to other animals carrying BVDV. Julia Ridpath, PhD, says these can include:

- Cattle shows
- Heifer-raising operations/calf ranches
- Contaminated semen
- Sharing equipment, especially transport equipment such as trucks, trailers, etc.
- Fenceline contact
- Contact with other species such as alpaca or sheep
- Contact with wildlife such as deer
- Clean-up bulls

Frank Bernard, DVM, Dipl. ABVP, says, "Biosecurity is a very big word. Each farm needs to evaluate the risk of introduction of the disease on the dairy, and control measures need to be defined, explained and understood by the working personnel and everybody that is doing business on the farm. There will be some holes, and these holes need to be identified and corrective measures taken immediately. Producers need to work with their veterinarian to establish a biosecurity plan."

need to remove it," states Rhoades. "A concurrent vaccine program is a safeguard against the amount of loss that could occur if a slip in overall biosecurity would occur in the future."

Over three years ago, Bernard started testing his clients' herds — all heifers were ear-notched from birth to first calving. Since then, every newborn female is tested on a weekly basis. When a PI animal is identified, the dam is traced back and also tested. "Working with a small herd, I will go in and ear-notch all animals on the farm, eliminating the risk of having older cows in the herd PI-positive," says Bernard.

Bernard notes that a 300-cow herd at $4 per ear-notch will represent an expense of $1,200. "If one or more positive cows are detected, it's a very good return on investment considering the damage the BVD virus can cause." If no animals are detected as PI, Bernard then continues to ear-notch newborns and incoming animals. "You have to be proactive," he says.

In Bernard's case, positive newborn animals are euthanized and positive older cows are immediately sent to slaughter.

Vaccine technology has vastly improved, but there are many reasons why vaccination alone won't solve the problem if PI animals are circulating in the herd, says Ridpath. "Not all animals give the same level of immune response to vaccination. There are low responders, which may have something to do with genetics, presence of other pathogens, stress, etc., and high responders. Low responders are the vulnerable ones. Further in the course of an animal's life, stress and other factors may result in temporary immune suppression. BVDV may sneak in past the immune response at this time."

Testing animals to detect a PI and a good vaccine program will help reduce the potential problem, adds Bernard. "All animals do not respond to a vaccine the same, but remember that we target the herd immunity and not the individual immunity." Bernard admits there will be some frustrating moments along the way because the BVD virus is an RNA virus and its mutation and replication do not fit one model. "Hopefully, the science will allow us to keep the challenge under control or at least to minimize the potential problems," he says.

We must get rid of PI animals and vaccinate, sums Ridpath. Failure to get rid of PIs will overwhelm any vaccination program. "Vaccines are not a silver bullet — they will reduce but not eliminate BVDV. The protection that vaccination provides for the herd will eventually be overwhelmed by the constant shed of virus from PI animals if they are left in the herd because of the sheer volume of virus shed by PIs," says Ridpath. "However, vaccines are needed because of the high rate of BVDV out there. Vaccines must be used in conjunction with surveillance of PI animals and good biosecurity." ■

Passive immunity and immune response

A fully functioning immune system can help fight off a BVDV infection, and that starts with the young calf.

Acquired immunity
- Derives from animal's own immune system
- Takes exposure and time to establish
- Can be due to B-cell response (antibody response measured by serology) or T-cell response (cell-mediated response measured by activity of cytolytic cells)

Passive immunity
- Derives from ingestion of antibodies prior to closure of gut
- Available to neonate immediately
- Measured by serology

In a study done by Ridpath *et al*., pregnant cows were vaccinated twice (one and two months prior to calving) with killed vaccine (BVDV1 and BVDV2). Colostrum and first milking milk was pooled. The experimental animals were 18 calves that were free of BVDV and antibodies to BVDV. The calves were fed colostrum or milk replacer in the first 48 hours of life then challenged at 3-5 weeks and/or 7-9 months (serum antibody titers at zero) with a virulent BVDV strain isolated from the 1993 Canadian outbreak.

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High-antibody-titer colostrums fed in the first 48 hours of life afford good protection against acute disease.

Ridpath and her researchers found that high-antibody-titer colostrums fed in the first 48 hours of life afforded good protection against acute disease, and there was a protective response mounted in the face of passive immunity. Results indicated that cell-mediated immunity may be a major factor in protection and animals exposed to virus in the face of passive immunity develop a protective response that is not reflected by serum antibody titers.