Systematic Large-scale Programs to Control BVD Virus

M. Daniel Givens, DVM, PhD, ACT, ACVM (Virology)

Bovine viral diarrhea virus (BVDV) creates unique challenges for immunity, herd health and biosecurity on the farm. This virus is a highly mutable, single stranded, positive-sense, RNA virus of the genus pestivirus and family Flaviviridae. It was first identified in 1946 as the causative agent of acute disease in dairy and beef cattle in New York State. The early clinical picture resembled that of rinderpest (a foreign animal disease) with high morbidity, low mortality and a spectrum of signs, including leukopenia, fever, depression, anorexia, excessive salivation and nasal discharge, ulcers of the nose, mouth and muzzle, diarrhea, dehydration and abortion. By 1962, the early form of the disease was rarely observed, but BVDV was often associated with a different syndrome in cattle termed mucosal disease. The later was sporadic, highly fatal and characterized by fever, severe diarrhea and erosions in gastrointestinal mucosa. An apparent return to the earliest clinical picture occurred in 1993 when BVDV again began to cause severe losses in dairy, beef and veal herds. High rates of abortion (44%) and high mortality among young and old cattle (25% and 53%, respectively) were observed. This severe form of acute disease was attributed to a novel species of BVDV (type II). Aside from the specific syndromes that have been observed over time, BVDV is also known to have more subtle consequences, including immune system dysfunction, early embryonic death and teratogenesis.

The economic impact of BVDV on beef and dairy industries is well known by those who deal with the disease in the field. Tangible estimates of losses are found in several reports. For example, when acute infections reach 34% within a population, total annual losses on a per calving basis were projected to be $20 when low-virulence strains were involved and $57 when highly virulent strains were involved. Another report estimated an average annual loss of $3,844 among 50-cow dairy herds. Since dairy states such as Michigan report that as many as 15% of dairy herds contained persistently infected animals (a key predictor of sustained herd infection), it is clear that the overall losses in the dairy industry alone are very high. Further, it should be noted that the true economic impact is underestimated because of subtle losses due to subfertility and immune system suppression.

The wide antigenic diversity among field strains of BVDV is due to the inability of the viral RNA polymerase to correct mis-incorporated nucleotides. This lack of proofreading ability results in a high frequency of viral mutations, approaching 1 error for every 10,000 nucleotides polymerized or an average of 1.25 nucleotide changes during each replication of each viral copy. Thus the genome of BVDV is not a single defined entity, but an average or consensus of a heterogeneous population of molecules. This strategy of replication generates genomes with potentially greater fitness and ability to survive under altered environmental conditions. This explains why some genotypes of BVDV such as type 1B appear to more commonly play a role in the bovine respiratory disease complex, while type 2 BVDV is more commonly involved in severe acute disease.

As the beef and dairy industries strive to eventually eradicate BVDV, vaccination and biosecurity must play equal roles in achieving this goal. Vaccines for BVDV conform to the Center for Veterinary Biologics policy (Notice No. 02-19; 9/5/02) concerning vaccine claims for protection against the reproductive effects of bovine virus diarrhea virus. Claims are type-specific (i.e., BVDV Type 1 or Type 2) under the following categories:

1. “Aids in the prevention of abortion:” This claim must be supported by studies in which abortions occur in an acceptable proportion of the non-vaccinated control cattle. Protection is evidenced by lack of abortion in vaccinated cows.

2. “Aids in the prevention of persistently infected calves:” This claim must be supported by challenging pregnant cattle at 75-90 days of gestation and performing virus isolation procedures on tissues from all fetuses on, or after, 150 days of gestation. Protection is evidenced by lack of virus isolation from fetuses obtained from vaccinated cows.

3. “Aids in the prevention of fetal infection” or “Aids in the prevention of fetal infection including persistently infected calves:” This claim may be supported by generating data to support the claim for “aids in the prevention of persistently infected calves” AND challenging a separate group of pregnant cattle at approximately 180 days of gestation and evaluating the fetuses (or calves) at, or after, 220 days of gestation. Serology and virus isolation procedures must be performed. Protection is evidenced by lack of detection of virus and antibodies from fetuses obtained from vaccinated cows.

Multivalent modified live viral vaccines are currently available in the United States that contain cytopathic strains of BVDV 1a and BVDV 2 as cytopathic strains are not considered to result in BVDV persistent infection. Though no BVDV vaccine provides complete protection in all circumstances, recent studies using multivalent MLV vaccines have demonstrated consistent BVDV fetal protection rates in the range of 85 to 100% in randomized, controlled clinical trials.

Appropriate, prolonged, and systematic use of diagnostic testing, biosecurity and vaccination could control the impact of BVDV on herd health and eventually eradicate BVDV in North America. Challenges to eradication of BVDV in the United States are segmentation of the cattle industry, the potential for BVDV to be maintained in host species other than cattle, the necessity of mandatory and readily traceable animal identification, and the optimal implementation of currently available diagnostic tests.

Due to the negative impact of BVDV on animal health and the inconsistency with which vaccines have been able to solely and completely control infection, several countries (Denmark, Finland, Norway, Sweden, the Shetland Islands, Slovenia, Scotland, Brittany in France, Germany, Austria, Switzerland, Scotland, and Ireland) have initiated eradication programs. Currently, all of the Scandinavian countries are currently either free, or almost free from BVDV. Furthermore, in November, 2001, the American Academy of Veterinary Consultants approved the following position statement: “The beef and dairy industries suffer enormous losses due to the effects of bovine viral diarrhea virus (BVDV) infection. The highly mutable nature of BVDV and the emergence of highly virulent strains of BVDV contribute to limited success of present control programs. Also, persistently infected cattle are the primary source of infection, and effective testing procedures are available to identify those infected carriers. Therefore, it is the resolve of the Academy of Veterinary Consultants that the beef and dairy industries adopt measures to control and target eventual eradication of BVDV from North America.” Thus, there is informed support for development and implementation of eradication programs for BVDV in this country.

References available from the author.