BVDV Impact on Feedlot Mortality and Morbidity

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Bovine Respiratory Disease

Bovine viral diarrhea virus (BVDV) contributes to the pathogenesis of a number of maladies such as bovine respiratory disease (BRD), reproductive wastage and acute enteritis. The causative role of BVDV in BRD is of greatest concern to the feedlot industry because BRD is by far the greatest cause of morbidity and mortality in US feedlots.[12,17,23] Up to 90% of morbidity and 75% of mortality is attributable to respiratory tract disease.[12,23] More cattle are treated or die from BRD than all other conditions combined.

Of cattle placed in feedlots nationwide, feedlot managers reported than 14.4% developed BRD.[17] Compelling evidence indicates this is an underestimate of the true proportion of animals that develop respiratory disease. Of animals not detected as being sick, 40 to 70% had evidence of bronchopneumonia at harvest.[4,25] Animals that suffered from clinically unrecognized BRD gained 0.15-0.44 lb (0.07 to 0.2 kg) per day less than animals not affected by BRD.[4,25] Furthermore, pulmonary lesions at harvest were associated with less desirable carcass characteristics.[4]

Bovine respiratory disease imparts a substantial economic burden on feedlots.[20] The exact cost of BRD, however, is unknown and estimates are difficult to calculate. Authors have reported losses of $458 to $624 million annually attributable to BRD.[20] Griffin reported BRD accounts for 7% of all production costs.[6] The greatest financial cost of BRD, however, likely results from decreased performance in animals with clinically undetected lesions.[4,25]

Despite our increased understanding of its pathogenesis, universal use of vaccines, and availability of efficacious antimicrobial drugs, the proportion of placements dying from respiratory disease has increased.[12]

Bovine Viral Diarrhea Virus in Feedlot Cattle

Rarely does BRD result from an uncomplicated viral or bacterial infection. Virtually all feedlot associated BRD results from a complex relationship between stressors, animal susceptibility and respiratory pathogens.[5] Viral agents and stressors decrease an animal's innate and acquired pulmonary defense mechanisms, thereby facilitating bacterial colonization of the lower respiratory tract. This gives rise to the underlying lesion of BRD, fibrinonecrotic bronchopneumonia.

Bovine viral diarrhea virus contributes to the pathogenesis of BRD through two important mechanisms:[3,19,24]

- as a primary respiratory pathogen[24] and
- generalized immunosuppression by altering macrophage and lymphocyte function.

One of the more insidious aspects of BVDV infection is its synergistic relationship with other respiratory pathogens. Cellular injury and disease are often greater when animals are co-challenged with BVDV. For example, the deleterious effects of BRSV on alveolar macrophages were substantially increased when BVDV was also present.[11] Experimentally-induced diseases associated with BHV1 or *Mannheimia haemolytica* were more severe if animals were concurrently challenged with BVDV.[2,10,18,22]

Qualifying and quantifying the effects of BVDV in feedlots has not been straightforward. Authors have often relied on serological evidence for exposure, or they frequently reported findings in a limited sample of affected animals. Interpretation of seroepidemiological studies is hindered in part because vaccination against BVDV is common.[16] Approximately 88% of feedlot cattle were vaccinated on arrival with either a killed or modified live vaccine containing BVDV,[16] even though well-controlled, real-world vaccine efficacy studies are generally lacking.

A substantial proportion of animals are reported to have BVDV-specific antibodies at feedlot arrival, indicating either prior natural or vaccine exposure.[1] In one study, animals with greater antibody titers to BVDV at arrival were less likely to require subsequent treatment for respiratory disease.[1] In another study,[15] seroconversion to BVDV was associated with increased risk for treatment for respiratory disease. Persistently infected animals are presumably a significant source of BVDV, however, Taylor estimated that the prevalence of persistently infected animals at feedlot arrival was less than 0.1%.[21]

Even though compelling data implicate BVDV as a causal agent of BRD, the magnitude to which BVDV

affects the health and well-being of feedlot cattle is unknown. Moreover, it is uncertain whether persistently or acutely infected animals are the primary source of the virus in feedlots. Describing the epidemiological characteristics of BVDV in feedlots and quantifying its effects is essential before we can accurately estimate the economic burden of BVDV to the feedlot industry.

The development of an immunohistochemical technique to identify a conserved BVDV antigen *in situ* has greatly increased our ability to study the epidemiology and ecology of this organism.[8] In a survey of chronically ill cattle at postmortem, BVDV was detected in excess of 40% of animals.[9] Moreover, BVDV was frequently associated with *M. bovis*. In another study, BVDV was identified (isolated or demonstrated using flourescent antibody detection) in 28% of normal lung tissue.[13]

Because persistently infected animals are presumably a significant source of BVDV, a better understanding of the epidemiology and effect of the presence of these animals is required. Grooms *et al* performed a study in which they followed two truck-loads (n=92 each) from Alabama to a research feedlot in Michigan.[7] One truck load also included two PI animals (one shedding type I and the other type II). Upon arrival, half of the cattle from each truckload were administered a BVDV-containing vaccine. Exposed and unexposed cattle were kept separate. Risks of treatment for disease were 29 versus 10%, and 18 versus 13%, for non-vaccinated exposed versus non-vaccinated unexposed and vaccinated exposed versus vaccinated unexposed, respectively. These data indicated that exposure was associated with increased risk of disease and vaccination provided some, but not complete, protection.

In another study,[14] the prevalence of PI animals at arrival varied from 0.16 (0.0, 0.3) to 0.25% (0.0, 0.5) for two groups of cattle of approximately 2,000 animals each (Figure 1). In the latter group of yearling steers, 5.8 (0.3, 11.5) and 25.5% (0.5, 49.5) of animals initially treated for respiratory disease and dead animals, respectively, were PI. In a separate cohort of approximately 1,300 chronically ill animals, 2.6% (2.2, 3.0) were PI. Thus, although relatively few PI animals enter feedlots, they are more likely to get sick and become either chronically ill or die than non-PI animals.

In the same study,[14] the investigators evaluated the incidence of initial treatment for respiratory disease in those cattle in contact with PI animals and compared those with no contact. A spatial association was evident in the data. The incidence of respiratory disease was 20 to 33% greater for cattle in contact with PI animals than those without contact, even though all animals were vaccinated against BVDV (Table 1).

The two studies by Grooms *et al* and Loneragan *et al* provide preliminary evidence that the presence of a PI animal is associated with increased risk of adverse health outcomes in exposed animals.[7,14] It is tempting to speculate that circulation of virus is responsible for the increase in disease and some evidence supports this.[7] In the Grooms study, no effect on performance or carcass attributes were detected.[7]

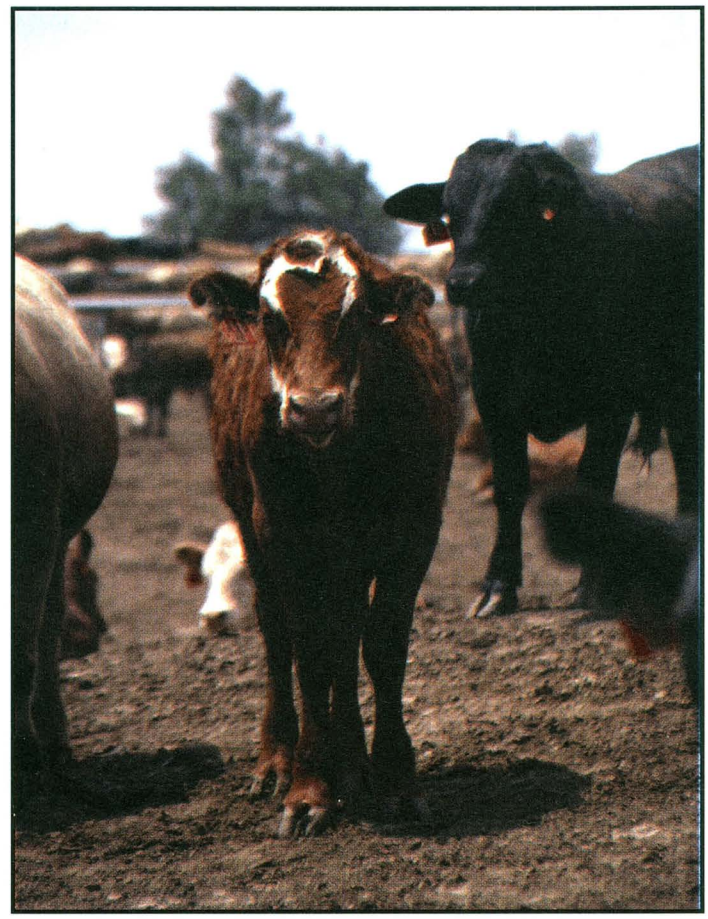

Figure 1. Animal persistently infected with bovine viral diarrhea virus. Photo courtesy of Geni Wren.

Table 1. Relative risks (RR), 95% confidence intervals (CI), and *P* values for incidence of initial treatment of respiratory disease in exposed cohorts relative to unexposed cohorts.

	Statistic		
Study	RR	95%CI	*P* value
1	1.33	0.9 to 1.9	0.1
2	1.2	1.0 to 1.4	0.06

Conclusions

It is well accepted that BVDV contributes to disease in feedlot cattle, most importantly BRD. Prelimi-

nary research indicates that PI animals are associated with an increased risk of treatment for BRD. If the excess disease observed is associated with acute BVDV infections, PI animals are, therefore, a significant source of virus for penmates. Other sources of exposure to BVDV include propagation and dissemination of acute infections, and immigration of new virus in acutely infected animals transported to the feedlot. More research is needed to better estimate excess morbidity associated with BVDV, partition this excess morbidity to exposure to PI animals or other sources, and estimate the economic burden of BVDV. Control measures (and as some have proposed, eventual eradication) can then be evaluated for their economic feasibility.

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