Factors Influencing Bovine Respiratory Disease in Stocker and Feeder Cattle

Robert A. Smith, *DVM, MS, DABVP*
Veterinary Research and Consulting Services, LLC, Stillwater, OK 74075

Abstract

Bovine respiratory disease (BRD) continues to be the major health problem of stocker and feeder cattle, despite many years of research and technological advances. Animal husbandry practices that reduce stress have long been shown to reduce BRD morbidity, such as reducing commingling, weaning/preconditioning, performing routine surgeries early in life, nutritional management, and biosecurity. These management practices complement vaccination programs by reducing stress, and ultimately morbidity rates.

This paper is not an in-depth review of management practices that influence morbidity, but rather cites several examples of how animal husbandry practices can reduce stress and associated morbidity rates.

Résumé

Le complexe respiratoire bovin (CRB) demeure le principal problème pathologique des bovins de court et de long engraissement, en dépit de nombreuses années de recherche et de progrès technologiques. On sait depuis longtemps que certaines techniques d'élevage qui réduisent le stress des animaux réduisent aussi la morbidité due au CRB, telles que la réduction du mélange d'animaux d'origine et de statut sanitaire divers dans les mêmes bâtiments, le sevrage et le préconditionnement, les interventions chirurgicales de routine sur les veaux encore jeunes, la gestion des aliments et la biosécurité. Ces pratiques d'élevage complètent les programmes de vaccination en diminuant le stress et ultimement la morbidité due à cette maladie.

Dans cette communication et dans cet article, nous ne décrirons pas en profondeur les techniques de gestion qui contrecarrent la morbidité, mais montrerons des exemples de pratiques d'élevage qui s'avèrent diminuer le stress et la morbidité qui s'y rattache.

Introduction

Bovine respiratory disease (BRD) remains the most costly disease of stocker and feeder cattle. Use of vaccines to reduce BRD without attention to management is often disappointing. Morbidity drives mortality, therefore utilizing animal husbandry or management practices that reduce BRD morbidity is the first step toward reducing animal suffering, premature culling, and death losses, as well as retaining desirable carcass traits.

A lot has been written about the relationships of weaning management, commingling, marketing, transportation, routine surgery, high concentrate diets, and other stressors to BRD. This information is often ignored in favor of metaphylactic antibiotic usage and seeking commercial products that enhance immune system function. While metaphylaxis is currently the most effective tool to manage BRD in high-risk stocker and feeder cattle, there are no other "magic bullets," and there are societal pressures to reduce usage of antimicrobials in food animal production systems. These factors emphasize the importance of reviewing the effect of BRD on performance, carcass quality, and cost of production, as well as how management practices can impact morbidity rates.

This paper will discuss the effect of selected management practices on BRD morbidity, but is not intended to provide an in-depth review of the subject.

Relationship of BRD to Performance, Carcass Quality, and Cost of Production

The Texas A&M Ranch to Rail program consistently demonstrated the negative impact of BRD on performance, carcass quality, and net economic return of feedlot steers. In an eight year summary,[17] 12,306 animals remained healthy during the feeding period, and 4,047 were treated for BRD. Average cost to treat steers for BRD was $27.03 per head. The average daily gain (ADG) of healthy steers was 2.99 lb (1.36 kg) compared to 2.67 lb (1.21 kg) for those treated for BRD. The percentage of steers grading USDA Choice was greater in those never sick, 39.6 vs 27.5%. Net economic return after the steers were harvested was $87.60 per head greater for steers that remained healthy.

Schneider *et al* reported results from similar studies conducted by Iowa State University.[22] Of 5,976 animals in the feeding studies, 8.17% were pulled and treated for BRD, while 61.9% had lung lesions at harvest, suggesting a high incidence of subclinical BRD. Cattle that had BRD at some time during the feeding period gained 0.15 lb (0.07 kg) per day less than those without clinical signs. Hot carcass weight was decreased by 18 lb (8.16 kg), and carcass quality grade was lower in cattle treated for BRD, compared to those not treated.

The decreases in performance and carcass traits in the study were associated with a decline of $23.23, $30.15, and $54.01 in carcass value when comparing cattle treated once, twice, or three or more times, respectively. Similarly, Fulton and co-workers at Oklahoma State University reported profitability was lowered with treatment for BRD.[9] Compared to calves not treated, calves treated once returned $40.64 less at harvest, those treated twice returned $58.35 less, and those receiving three or more treatments returned $291.93 less.

Treatment for BRD prior to feedlot entry has also been shown to reduce quality grade. Heifers were shipped to a feedlot after a 42 day preconditioning period, and carcass data were collected at harvest. A total of 66.19% of heifers never treated for BRD during the preconditioning period graded USDA Choice, while those treated once or two or more times graded 59.36 and 41.11% Choice, respectively.[27] Studies such as these clearly demonstrate that the cost of BRD morbidity is much greater than just medicine and associated death loss.

Commingling of Calves

Commingling of stocker and feeder cattle is an often overlooked stressor that increases risk of BRD. In a recent USDA survey, 82.4% of cattle operations in the United States reported marketing their cattle or weaned calves through auctions, similar to the results of a 1997 survey.[29] Because of the large number of producers who own a small number of cows, this method of marketing beef cattle is likely to continue because of convenience and the competitive price discovery offered by the auction market system.

Ribble and co-workers determined that an average truckload of feeder steers arriving at a large, western Canadian feedlot comprised calves from as many as 20 to 30 farms.[21] They concluded that "increased mixing of calves from different farms at the auction market increases the risk of fatal pneumonia in those calves after their arrival at the feedlot". Furthermore, they stated that "a feedlot manager might be able to use the number of individual auction market tickets accompanying an incoming truckload of calves as a rough indicator of the problems that may be encountered with fatal pneumonia in calves from that truckload, compared with that from other truckloads arriving in a similar period".

Commingled cattle in an Iowa feedlot had a morbidity rate approaching 29%, compared to 7.9 to 11.9% in single source cattle.[19] Step and co-workers compared auction-origin feeder calves to ranch-origin calves that were unweaned, weaned 45 days, or vaccinated and weaned for 45 days; morbidity rates were 31.9, 22.2, 5.0, and 7.7%, respectively.[24]

Larger lot sizes demand significantly higher prices than similar quality cattle sold as singles or in smaller groups. A Kansas State University study showed that the largest price premiums for feeder cattle were for truckload lots, with premiums approximating $6 per 100 lb (45.45 kg) relative to single-head lots.[12] These premiums result from ease of assembling semi-load lots of cattle when large uniform groups are offered for sale, and because morbidity rates are typically lower when there is less commingling.

There is little doubt that commingling will remain a common practice as cattle are marketed and assembled for grazing or feeding, but when possible producers should seek ways to minimize commingling. Obviously a significant proportion of producers do not own enough cattle to sell load-lots of cattle. However, managing the breeding season is one way to produce a more uniform calf crop to market in larger groups to bring higher prices and reduce risk of morbidity. In addition, managing other stressors will lessen the effects of commingling on morbidity.

Weaning and Preconditioning

Weaning management of beef calves can have a sparing effect on morbidity. Step *et al* showed that calves weaned for 45 days had pull rates of 5.0% (weaned only) and 7.7% (vaccinated and weaned) compared to unweaned ranch calves (22.2%), while commingled auction-origin calves shipped to the same Oklahoma research feedyard had a 31.9% morbidity rate.[24]

A large scale trial was done in a commercial feedyard in the Texas Panhandle to compare calves placed on feed without weaning to those preconditioned on the ranch 45 days prior to shipment; all calves originated on the same ranch.[7] Calves weaned 45 days before feedlot entry had 0.2 lb (0.09 kg) greater ADG, required 0.58 lb (0.26 kg) less feed per pound (0.45 kg) of gain, $29.67 less medicine cost per head, and 1.3% death loss compared to 4.44% in the unweaned calves. Cost of gain in preconditioned calves was $8.05 per 100 lb of gain less, and the net economic return when cattle were marketed for harvest was $60.72 per head higher in the preconditioned calves.

In a second study, Cravey compared preconditioned calves (n=1685) to non-preconditioned calves (n=1492) of similar quality, weight, and age.[7] Days-on-feed (DOF) ranged from 205 to 217 days. Compared to non-preconditioned calves, preconditioned calves had higher ADG (2.88 vs 2.59 lb or 1.31 vs 1.17 kg); better feed conversion (5.98 vs 6.45 lb); lower average medical cost ($13.74 vs $30.66); lower morbidity (19.0% vs 62.0%); lower cost of gain ($49.68 vs $56.70 per 100 lb; and had $55.93 higher net value at harvest.

The market has recognized the value of cattle vaccinated and weaned for 45 days or more. In a summary of sale premiums for "VAC45" calves sold through Superior

Livestock Video Auctions, King *et al* reported buyers paid a $2.47 per 100 lb premium in 1995, which increased to $7.91 per 100 lb by 2004.[14] The data shows that VAC45 calves had to "earn their stripes" or prove their worth before buyers were willing to pay higher premiums. These data support the notion that calves weaned 45 days or more have increased value and, although not stated specifically in the summary report, this is largely due to fewer health problems for the buyers.

Colostrum and Morbidity in the Feedlot

Researchers at the University of Nebraska tested neonatal beef calves for failure of passive transfer, and monitored the calves from birth through the feedlot.[32] Calves with inadequate passive transfer of maternal antibodies were at greater risk of respiratory disease (odds ratio 3.1) while in the feedlot compared to calves with adequate transfer. This demonstrates that events which interrupt timely consumption and absorption of maternal antibodies influence morbidity, but there is no practical way of knowing the history of each calf under commercial stocker or feedlot conditions. However, it does emphasize the importance of providing supplemental colostrum or colostrum substitute when natural consumption is in doubt, and that the root cause of respiratory morbidity in some stocker and feeder cattle could have occurred as early as the first day of life.

Disposition and Morbidity

The temperament or disposition of stocker and feeder cattle varies greatly, and in this author's experience the majority of buyers view wild disposition as "part of the business." Busby *et al* disposition-scored over 13,000 head of cattle entered into the 2002-2004 Iowa Tri-County Steer Carcass Futurity. Scoring was done several times while the cattle were on feed, and disposition-scored as docile, restless or aggressive. The morbidity rate was lower in restless (16.82%) and aggressive (16.18%) cattle compared to those scored as docile (19.23%), but death loss was higher in aggressive cattle. Carcass merit and ADG were lower in aggressive cattle, which combined with the higher death rate resulted in aggressive cattle being worth $62.19 less than docile cattle.[5]

Vaccine Selection and Morbidity

Many viral antigen combinations are commercially available for use in cattle, ranging from single-antigen infectious bovine rhinotracheitis (IBR) vaccine to "5-way" IBR, bovine viral diarrhea virus (BVDV; type 1, type 2, or both), bovine respiratory syncytial virus (BRSV), parainfluenza-3 (PI_3) combination vaccine, and various modified-live virus (MLV) and/or inactivated preparations. Studies reporting clinically relevant outcome comparisons for various vaccine combinations are useful to practitioners and producers. Specifically, the effect of vaccines on morbidity, mortality, performance, carcass quality, and net economic return are of value for veterinarians to make vaccine selections.

Schunicht *et al* compared MLV IBR vaccine to combination IBR, BVDV, BRSV, PI_3 vaccine.[23] Calves vaccinated with combination MLV IBR, BVDV, BRSV, PI_3 vaccine had greater live weight, carcass weight, and ADG; carcass merit was similar between the two vaccine groups. Morbidity was higher (P=0.001) in calves vaccinated with IBR vaccine alone (21.73%) compared to those vaccinated with the multivalent virus vaccine (16.78%). The authors concluded it was more cost-effective to vaccinate auction market calves with IBR, BVDV, BRSV, PI_3 than single-antigen IBR vaccine.

MacGregor vaccinated more than 19,000 yearling cattle with either MLV IBR-BVD-PI_3 or MLV IBR-BVDV-BRSV-PI_3 vaccine. Overall respiratory morbidity rates were low but similar between vaccine groups; the respiratory mortality rate was lower (0.3%) in the 4-way vaccine group than in the 3-way vaccine group (0.7%), but both were very low. No performance differences were noted, and carcass merit was similar except for USDA Yield Grades 2 and 3.[16]

As part of a larger feedlot study, Bryant *et al* compared the use of MLV IBR, BVDV (types 1 and 2), BRSV, PI_3 vaccine to MLV IBR-BVDV (types 1 and 2) vaccine produced by the same manufacturer. Cattle were classified as high-risk; caretakers were blinded to treatment assignment. There were no differences in morbidity, relapse rate, total relapse, death loss, culling rate, or performance between vaccine treatment groups.[3]

Likewise, Van Donkersgoed *et al* reported no significant effect of BRSV vaccine on morbidity rate in calves vaccinated at weaning, in calves vaccinated at arrival-processing at a bull test station, or in yearlings vaccinated upon arrival at the feedlot. There was a significant reduction in morbidity rate in one of three groups of calves vaccinated prior to weaning and in calves vaccinated prior to feedlot entry. The authors concluded that there was a trend towards a sparing effect on morbidity, but that the small reduction in the treatment rate may not justify the cost of the vaccine.[30]

The number of days between initial and booster vaccination of calves vaccinated on the farm of origin and weaned 30 days or more significantly affected the morbidity rate when commingled with other calves at a backgrounding facility.[31] Pens of calves with less than 14 days between vaccinations had a significantly higher (29.8%) morbidity rate than calves in the 14-28 day range (10.6%, P = 0.03) and those in the greater than 28 day group (12.3%, P = 0.08). Fulton *et al* evaluated

the vaccination history of calves from 24 herds shipped to a commercial feedlot. Calves from herds with the highest morbidity were either not administered a booster dose of viral vaccine, or were re-vaccinated just prior to shipment.[9] These studies suggest that timing of vaccinations in advance of stress and commingling can have a significant effect on morbidity.

Morbidity is Higher in Bulls

Unfortunately, a significant number of male calves are marketed as bulls, which are typically castrated after arrival at North American stocker and feedlot operations. Male calves offered for sale that have been castrated and healed have more value than those not castrated. In a Texas study of calves purchased to graze summer grass, the morbidity rate was 60% for bulls castrated after arrival compared to 28% in comparable quality steers.[20] Castration after arrival led to a 13.5% loss in ADG and a 10.3% loss in season-long gain. Bull calves castrated after arrival that became ill had $48.52 less value than steers that remained healthy; healthy bull calves returned $22.10 less than healthy steer calves at the end of the grazing period.

Burciaga-Robles *et al* compared bulls castrated at arrival processing to similar-sized steer calves in a 44-day preconditioning study, and the differences were dramatic. Morbidity was 42.3% in bulls castrated after arrival compared to 11.3% in steers, while mortality was 23.4 and 3.9%, respectively. Health differences were also reflected in medicine cost, which was $12.30 per head in calves arriving as bulls compared to $2.65 for steer calves. ADG was significantly higher in steer calves compared to bulls, 3.57 lb (1.62 kg) per day vs 2.98 lb (1.35 kg) per day, respectively.[4]

There is ongoing debate about whether surgical castration or banding results in more morbidity, and the literature contains winners and losers for both techniques. Many reports used few animals, and/or followed the calves for a relatively short period of time after the procedure was performed. In a recent report by Booker *et al*, the study extended from the time of castration (surgical or banded) until harvest. Morbidity was 28.5% (P=0.021) lower in banded bulls compared to those castrated surgically, while mortality was similar (P=0.981) between groups.[2]

There is little doubt that castration of stocker and feeder cattle increases risk of morbidity. Male calves should be castrated early in life to address animal welfare concerns, reduce risk of morbidity and mortality, and to improve production efficiency. Administering a growth-promoting implant to young calves at the time of castration results in weaning weights similar to bulls left intact.[1]

Effect of Exposure to BVDV PI Calves on Morbidity

Laboratory tests to identify cattle persistently infected (PI) with BVDV, such as immunohistochemistry, antigen capture-ELISA, and polymerase chain reaction, are inexpensive and offer rapid and accurate results. Consequently, testing of stocker and feeder cattle has become common. Several articles have reported the relationship of PI calves to morbidity in stocker and feeder cattle, providing information to help veterinarians and cattle owners make testing decisions. In 2005, O'Connor *et al* examined the relationship between exposure to PI animals and morbidity rates in feedlot cattle.[19] The morbidity rate in single-source feedlot calves exposed to a PI animal was 7.9%, compared to 11.9% in single-source calves not exposed to a PI animal. Morbidity rates were similar in exposed vs non-exposed commingled cattle, 28.6% and 29.3%, respectively.

Two trials were conducted by Kansas State University researchers. In the first,[25] feedlot calves were tested at 10 to 14 DOF, and PI animals were removed from the pens at 13 to 18 DOF. Exposure to a PI animal had no effect on performance or carcass quality grade, but the morbidity rate was higher (P<0.01) in cattle exposed to PI animals (29.8%) than those not exposed (18.8%). As a result, medical costs were $2.28 per head greater for cattle exposed to PI cattle, but the medical cost advantage was less than the cost of testing. Cattle in the second study were tested at arrival processing, and PI animals were removed from the pens at 1 to 2 DOF instead of 13 to 18 DOF as done in the earlier study. The morbidity rate was higher (7.0%) in cattle not exposed to a PI calf compared to exposed cattle (2.7%); there were no differences in ADG or feed efficiency between groups.[26]

Elam and co-workers used 500 lb (227 kg) beef cattle vaccinated against BVDV to compare the effect of short-term exposure, long-term exposure, or no exposure to a PI calf on morbidity, dry matter intake, ADG, and feed efficiency. No differences between treatment groups were found.[8] In a Canadian feedlot study, at least one PI was found in each of nine pens (13 PI cattle total), while no PI cattle were present in 16 pens. There were no differences in morbidity or mortality outcomes except deaths due to BVDV-associated enteritis. In general, health was numerically improved in PI pens. Performance did not differ.[11]

Hessman *et al* evaluated the economic effects, health, and performance of the general cattle population in a large starter feedlot after exposure to cattle PI with BVDV.[13] Cattle were divided into five exposure groups. PI were lots with PI cattle in them at arrival, the PI animals were left in the lot throughout the study, and adjacent pens contained a mixture of PI and non-PI

cattle. The second group was designated as PIR, which comprised a lot where PI cattle were present at arrival, but the PI cattle were removed within 72 hours of arrival. Adjacent pens contained a mixture of cattle from lots with no PI cattle at arrival, or the PI cattle were removed within 72 hours after arrival. The third group (non-PI exposed or NPIE) were lots where there were no PI cattle in the lot at arrival, but cattle were exposed because an adjacent pen(s) contained one or more animals. The fourth group (non-exposed cattle adjacent to a pen from which PI cattle were removed [NPIER]) were lots where no PI cattle were in the pen at arrival, but cattle were exposed because an adjacent pen(s) contained animals from which PI cattle were removed within 72 hours of arrival. The fifth group (non-PI unexposed group [NPIU]) was comprised of lots where there were no PI cattle in the lot at arrival, and no PI cattle were in adjacent pens at arrival.

Morbidity percentage for the PIR group was similar to the PI group, suggesting that exposure to PI cattle prior to testing and removal was harmful, and that removal of the PI animal(s) did not result in improved health. Mortality percentage in the PI and PIR groups was similar, but the death rate in these two groups was significantly higher than the death percentage in the NPIER and NPIU groups. In contrast to another study conducted in a commercial feedlot setting,[15] cattle in the NPIE group did not suffer differences in morbidity, mortality, chronic rate, ADG, or cost of gain compared to the NPIER or NPIU groups. This suggests that cattle in pens without a PI animal present were not at greater health risk when a PI animal was housed in an adjacent pen. For more detailed information on the results of this study, the reader is referred to the original article.[13]

Results of these studies offer little support for testing incoming stocker and feeder cattle for the presence of PI animals. The American Association of Bovine Practitioners, the Academy of Veterinary Consultants, and the National Cattlemen's Beef Association have ongoing programs to educate veterinarians and producers on how to diagnose and manage BVD in cattle herds. Likely more progress in reducing problems associated with PI animals will be made by targeting education and control programs at the cow-calf level of production.

Metaphylaxis

Metaphylaxis is the most effective tool to reduce morbidity in high-risk stocker and feeder cattle. The benefits of metaphylaxis are well supported by research,[6,10,18] and it typically results in a 50% reduction in morbidity,[28] and in this author's experience reduces BRD mortality by 30 to 50%. When properly used, metaphylaxis is very cost-effective.

In recent years, concerns arose about "overuse" of antimicrobials in food animal production systems, and criticism of "mass treatment" will likely continue. While this practice minimizes morbidity and animal suffering due to BRD, the beef industry should continue to adopt management practices that will reduce morbidity, mortality, and the need for antimicrobials.

Conclusions

This paper cites several examples of management practices that reduce stress and associated morbidity caused by BRD. By more widespread adoption of practical and proven management practices, morbidity, mortality, and production losses can be reduced in stocker and feeder cattle. Stress management to reduce BRD should continue to be emphasized in producer-oriented educational programs; data suggest the marketplace is willing to reward producers of low-risk cattle.

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