PEER REVIEWED

Effect of Testing and Removal of Feeder Calves Persistently Infected with Bovine Viral Diarrhea Virus at the Time of Feedlot Arrival and Outcome on Health, Performance, and Carcass Characteristics

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Abstract

Twelve lots of auction-derived steers totaling 1,577 head with an unknown health history (initial body weight 660 lb [300 kg]) were used to investigate testing and removal of feeder calves persistently infected with bovine viral diarrhea virus (PI-BVDV) upon arrival at a single feedlot in central Kansas. Pens with a PI-BVDV calf present at arrival were considered exposed and were compared to pens of steers that arrived without a PI-BVDV calf in the group. Both exposed and non-exposed pens of steers were followed from arrival through harvest to investigate the impact of exposure on health, performance, and carcass characteristics of feedlot cattle. A significant difference in the morbidity between exposed (2.3%) and non-exposed (7.2%) cattle was found ($P<0.01$). No differences in retreatment or mortality rates were found between groups. Exposure to a PI-BVDV animal for less than 48 hours after arrival did not have an effect on performance parameters. There was an increased percentage of USDA yield grade 4 and 5 ($P=0.01$) carcasses in the exposed cattle, but no other differences in carcass characteristics were found between groups.

Keywords: bovine, BVDV, persistently infected, PI, feedlot

Résumé

Un total de 12 lots de bouvillons d'encan, comportant 1577 têtes dont on ne connaissait pas les antécédents médicaux (poids initial de 660 lb [300 kg]), ont été utilisés pour examiner l'effet de tester et de retirer des veaux d'engraissement immunotolérants au virus de la diarrhée virale bovine (PI-BVDV) à leur arrivé à un parc d'engraissement du centre du Kansas. Les enclos avec un veau immunotolérant à l'arrivée étaient considérés exposés et ont été comparés aux enclos de bouvillons qui n'avaient pas de veaux immunotolérants dans le groupe. Les deux types d'enclos étaient suivis de l'arrivée jusqu'à l'abattage pour examiner l'impact de l'exposition sur la santé, la performance et les caractéristiques de carcasse des bovins de parc d'engraissement. Il y avait une différence significative au niveau de la morbidité entre les enclos exposés (2.3%) et les enclos non-exposés (7.2%) ($P<0.01$). Il n'y avait pas de différence significative entre les deux groupes au niveau du nombre de retraitement et du taux de mortalité. L'exposition à un animal immunotolérant pendant moins de 48 heures après l'arrivée n'avait pas d'impact sur les paramètres de performance. Il y avait un pourcentage accru de carcasses avec catégorie de rendement USDA 4 ou 5 ($P=0.01$) chez les bovins exposés. Toutefois, il n'y avait pas de différences significatives entre les groupes au niveau des autres caractéristiques de carcasse.

Introduction

Bovine viral diarrhea virus (BVDV) is an important pathogen of cattle, and infection can lead to a variety of adverse health outcomes such as enteritis, abortion, fetal malformations, and bovine respiratory disease (BRD).[7] The outcome of BVDV fetal infections in susceptible heifers and cows is dependent on the age of the fetus when exposed. Persistent infection in a calf develops when a susceptible fetus is exposed to non-cytopathic BVDV during pregnancy at approximately 45 to 125

days of gestation.[8] Persistently infected (PI) animals are a continuous source of virus and can shed the virus in virtually all secretions and excretions, including nasal discharges, saliva, semen, urine, tears, milk, and, to a lesser extent, feces.[1,3,4,10]

Prevalence of feeder cattle PI with BVDV entering feedlots is estimated to be 0.3%.[7,12] During the feeding period, calves PI with BVDV tend to have lower growth rates and often die from mucosal disease.[9] Although few cattle PI with BVDV arrive at feedlots, the risk of initial treatment for BRD in one study was 43% greater in cattle exposed to a PI calf.[7] Given the potential negative impact of exposure to a calf PI with BVDV, it may be advantageous to test newly arrived cattle. There are a number of tests available to practitioners; however, the BVDV antigen capture enzyme-linked immunosorbent assay (ACE) is often used for the initial screening of feedlot cattle. A number of sample handling practices have been evaluated and found to have little impact on test sensitivity and specificity of ACE testing for BVDV.[6,11]

Effects of testing and removing PI cattle at revaccination (10-14 days-on-feed) were determined in a previous study.[12] No differences for mortality rates, retreatment rates, performance, or carcass characteristics were evident. Morbidity rates were different between the non-exposed and exposed groups (19% for non-exposed vs 30% for exposed). Based on these findings, this trial was conducted to assess the impact of testing for and removing PI cattle within two days after arrival.

Cattle Management and Sample Collection

Twelve lots of auction-derived steers totaling 1,577 head with an unknown health history (initial BW 660 lb, ± 50.9; 300 kg ± 23.1) arrived at a 12,000 head capacity commercial feedlot in central Kansas between March and October 2006. After arrival into the feedlot, cattle were placed in receiving pens and offered free choice hay and water. Cattle were processed after being allowed one hour of rest for every one hour of transport to the feedlot; all calves were processed within 24 hours of arrival. At processing, animals received a unique identification tag and administered doramectin,[a] a multivalent modified-live virus vaccine containing infectious bovine rhinotracheitis, parainfluenza-3, BVD (types 1 and 2), and bovine respiratory syncytial virus vaccine,[b] and a steroid growth implant.[c] During initial processing, fresh skin (ear notch) specimens were collected and placed in phosphate-buffered saline solution to be tested for BVDV antigen by ACE.

After initial processing, cattle were housed in 12 pens (range 62-302 animals/pen) and managed in accordance with routine feedlot practices. Ten to 14 days after initial processing, cattle were administered a second MLV vaccine[d] and a multivalent clostridial bacterin-toxoid.[e]

Animals that exhibited one or more clinical signs consistent with BRD (depression, mucopurulent nasal discharge, increased respiratory rate and effort, and/or anorexia) were removed from the home pen for further diagnosis. Animals with a rectal temperature greater than 103.5°F (39.7°C) were treated with tulathromycin.[f] Relapses were defined as animals that had been treated for BRD, and subsequently were diagnosed as a treatment failure or "sick". Calves classified as first relapse were treated with florfenicol,[g] and those diagnosed as second relapse were treated with ceftiofur sodium.[h] It is standard practice at this feedlot to test all cattle for PI-BVDV and remove those that test positive.

Antigen Capture ELISA

Detection of BVDV antigen in skin specimens (ear notch) was performed using a commercial ACE kit.[i] Results were calculated by the following equation: standardized optical density (OD) = (raw OD of sample – raw OD of negative control)/(raw OD of positive control – raw OD of negative control). Samples with standardized OD values <0.20 were considered negative, and those with OD values >0.39 were considered positive. Samples with values from 0.20 to 0.39 were retested with detector reagents with or without antibody. Upon secondary analysis, no animals had values from 0.20-0.39. Animals that tested positive by ACE were removed from the pen, isolated, and retested 21 days later by immunohistochemistry (IHC) for confirmation of PI-BVDV status.

Assignment to Treatment Group

All cattle that arrived at the feedlot were tested for PI-BVDV by ACE. If an animal tested positive for BVDV using ACE testing, it was removed from the home pen (range=1-2 days-on-feed). Not all pens that were tested contained a PI-BVDV animal. When an animal PI with BVDV was found in a pen (exposed; EXP), a pen with no PI-BVDV (not exposed; NE) animals was identified, therefore creating a pair of pens for comparison. Paired pens were similar with respect to in-weight, date of arrival (same week), sex, and geographical origin. After a pair of pens was enrolled, the EXP and NE pens were followed through closeout and harvest.

Health and Performance Data

Feedlot data were collected from electronic records maintained at the feedlot. Data obtained from the closeout sheets included initial body weight (BW), final BW, days-on-feed, average daily gain (ADG), dry matter intake (DMI), feed-to-gain (F:G), and feed cost per pound of gain (COG). Initial and final BW was determined by

the average weight of the lot at the time of arrival and harvest, respectively. Health data were recorded daily by trained feedlot personnel. Feedlot management and pen riders were masked (blinded) from treatments. Pens of cattle were harvested based on visual appraisal as well as targeted harvest dates. Paired pens were harvested at approximately the same time (within the same week). Health data collected from the animal health computer system[j] included respiratory morbidity rate, number of treatments, death loss, and treatment costs.

Statistical Analysis

Performance based data (ADG, DMI, initial BW, final BW, F:G, dressing percent, and COG) were analyzed as a single factor experiment using the general linear model of SAS release 9.1.3.[k] Pen was the experimental unit. Non-parametric data (morbidity rates, retreatment rates, mortality rates, quality grade, and yield grade) were tested as binomial proportions using the GLIMMIX procedures in SAS. Percentages are reported in tables for animal health and carcass variables. The largest standard error of the least squares means is reported in the tables.

Results

Five of the six EXP pens contained one PI animal, and one EXP pen contained four PI animals. Following a positive ACE test, PI animals were removed from the home pen and housed separately from the study population. Health and performance of positive animals were not recorded.

Animal health and feedlot performance data are shown in Tables 1 and 2. Morbidity rate was higher in NE pens ($P<0.01$) than EXP pens. There were no differences between groups for retreatment rate or mortality rate. Performance, including ADG, DMI, F:G, and COG, was similar ($P\geq0.28$) in EXP and NE groups. No differences were found in dressing percent ($P=0.55$) or quality grade ($P=0.46$) of carcasses between EXP and NE groups (Table 3). There were no differences for calculated yield grades 1 and 2 ($P=0.46$) or yield grade 3 ($P=0.26$) between different BVDV exposure groups of cattle; however, percentage of carcasses with a calculated yield grade of 4 and 5 was higher in EXP cattle than NE cattle ($P=0.01$).

Discussion

In this study, cattle with no exposure to PI-BVDV calves early in the receiving period had higher morbidity rates than cattle exposed to a PI calf; however, morbidity rates for both groups of cattle were less than 8% (Table 1). Research on the effects of exposure to PI-BVDV animals in the feedlot has produced mixed results. In an earlier study conducted at this facility, cattle with short-term exposure to a PI animal (tested at day 10-14 and removed at day 13-18) had higher morbidity rates than cattle with no exposure (30% vs 19%, respectively).[12] In a large pen study, Loneragan *et al* found that cattle within a pen that contained a PI animal were at slightly greater risk of BRD than non-exposed cattle. A more profound impact was found when adjacent pens were included in their analysis. When adjacent pens were included

Table 1. Health outcomes of feeder cattle exposed (EXP) or not exposed (NE) to a calf persistently infected with bovine viral diarrhea virus on arrival to a commercial feedlot. Variables are least squares means expressed as percents.

Variable	EXP	NE	SEM	*P*-value
No. pens	6	6		
No. animals	909	668		
Initial weight, lb	647	679	50.9	0.66
Initial BRD treatment,[1] %	2.7	7.0	3.0	< 0.01
Retreatment rate,[2] %	4.8	0.5	3.4	0.29
Mortality rate,[3] %	1.6	1.2	0.5	0.41

[1]Initial bovine respiratory disease (BRD) treatment rate is the number of animals treated for BRD divided by the number of animals placed in the study.
[2]Retreatment rate is the number of cattle treated a second or third time for BRD divided by the number of animals first treated for BRD.
[3]Mortality rate is the number of cattle that died of BRD divided by the number of animals placed in the study.

Table 2. Performance of feeder cattle exposed (EXP) or not exposed (NE) to a calf persistently infected with bovine viral diarrhea virus on arrival to a commercial feedlot. Variables presented are least squares means.

Variable	EXP	NE	SEM	*P*-value
Initial BW,[1] lb	647	679	50.9	0.66
Final BW, lb	1216	1147	36.9	0.22
ADG,[2] lb/day	2.6	2.4	0.16	0.28
DMI,[3] lb/day	20.1	19.3	1.3	0.67
F:G[4]	7.7	8.1	0.38	0.43
COG,[5] $/lb	0.86	0.87	0.06	0.92

[1]BW is body weight
[2]ADG is average daily gain
[3]DMI is dry matter intake
[4]F:G is the feed-to-gain ratio
[5]COG is cost of gain for the entire feeding period

Table 3. Least squares means carcass characteristics from pens of feeder cattle exposed (EXP) or not exposed (NE) to a calf persistently infected with bovine viral diarrhea virus on arrival to a commercial feedlot.

Variable	EXP	NE	SEM	*P*-value
Dressing percent, %	62.8	62.4	0.52	0.55
USDA quality grade				
Choice/Prime, %	81.7	81.4	6.1	0.46
Select or other, %	18.3	18.8	6.1	0.46
USDA yield grade				
1 and 2, %	26	31	4.4	0.46
3, %	59.8	62	3.8	0.26
4 and 5, %	14.2	7	3.2	0.01

in the analysis, the incidence of treatment for respiratory disease was 43% greater.[7] In contrast, Booker *et al* found no difference in the respiratory morbidity rate of cattle in pens that contained a PI animal compared to those not exposed to a PI animal; they were not able to evaluate the health of cattle in adjacent pens. There was no difference in total mortality; however, there was a difference in BVDV/enteritis mortality.[2] In a small pen study, Elam *et al* found no differences in animal health within pens and adjacent pens that had short- or long-term exposure to PI-BVDV animals.[5] In our current study, adjacent pens were not analyzed because there were no fence-line water tanks in the feedlot. In addition, all groups were housed next to pens that did not contain a PI animal at any time during the study.

Interestingly, there was a significant difference ($P<0.01$) in the morbidity rate between cattle with no exposure to a PI-BVDV animal (7.2%) and those exposed to a PI animal (2.3%). In a longitudinal study at a custom cattle feeding operation in Iowa, O'Connor *et al* reported that inclusion of a calf PI with BVDV in a pen was associated with reduced disease risk for undifferentiated bovine respiratory tract disease (UBRTD) and chronic disease (odds ratio <1).[9] In that study, the authors reported a decrease of approximately 30% in the risk of UBRTD in a pen containing a PI-BVDV calf compared with the risk of UBRTD in a pen without a PI-BVDV calf. Furthermore, the mean cumulative incidence of morbidity attributable to any disease during the feeding period was lowest in pens that contained cattle from a single source and a PI-BVDV calf, compared with the mean cumulative incidence of morbidity in pens containing cattle from a single source and no PI-BVDV calf.[9] This suggests that exposure to a PI-BVDV calf prior to feedlot entry may actually better prepare herdmates of PI calves for disease exposure compared to calves with no prior exposure to a PI animal.

No differences were found in performance variables during the study period. Carcass quality was not affected; however, there was an increase in yield grade 4 and 5 carcasses in the EXP group. Results from the study by Elam *et al* found no differences in final BW, DMI, ADG, and F:G in calves with direct or adjacent exposure to a PI-BVDV calf, but PI-exposed cattle tended ($P\leq0.12$) to gain less through day 28. These differences, however, were not detectable by day 56. Booker *et al*[2] reported no significant differences in ADG or dry matter-to-gain ratio between PI pens and non-PI pens of cattle.

A limitation to the present study was the lack of a treatment group that contained a PI-BVDV animal that was not removed after testing positive. This would have allowed for a greater understanding of the impact that a calf PI with BVDV might have on health and performance measures under our study conditions. Future research efforts should be directed towards understanding the role of a PI-BVDV animal when it is not removed from the pen when fed in commercial feeding systems.

Conclusions

Under the conditions of this study, there were no harmful outcomes when newly arrived feeder cattle were exposed to a PI animal for one-to-two days following feedlot entry.

Endnotes

[a]Dectomax Injectable, Pfizer Animal Health, New York, NY
[b]Arsenal 4.1, Novartis Animal Health, Greensboro, NC
[c]Component E-S, Vetlife, West Des Moines, IA
[d]Vista 5 SQ, Intervet, Millsboro, DE
[e]Vision 7, Intervet, Millsboro, DE
[f]Draxxin, Pfizer Animal Health, New York, NY
[g]Nuflor, Schering-Plough Animal Health, Union, NJ
[h]Naxcel, Pfizer Animal Health, New York, NY
[i]Idexx Laboratories Inc., Westbrook, ME
[j]Walco International, Amarillo, TX
[k]SAS System for Windows 9.1.3, SAS Inst. Inc., Cary, NC

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