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Comparison of ceftiofur crystalline free acid to tilmicosin for metaphylactic treatment of calves at risk for bovine respiratory disease

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Abstract

Efficacy of metaphylactic ceftiofur crystalline free acid (CCFA) or tilmicosin phosphate (TIL) on performance and health of newly received calves at risk for bovine respiratory disease (BRD) was compared. Crossbred bull (n = 39) and steer (n = 264) calves (initial BW = 464 ± 27.7 lb (211 ± 12.6 kg)) were received on 3 dates. Calves were stratified to pens by castrate status and BW. Pens were assigned randomly to single-dose antimicrobial metaphylaxis: 1) CCFA or 2) TIL. No differences ($P \geq 0.23$) in average daily gain were observed between metaphylactic treatments. Morbidity (calves treated at least once for BRD) rates were 19.9 and 15.1% ($P = 0.13$) for calves in the CCFA and TIL groups, respectively. Calves treated for clinical BRD after metaphylactic treatment with CCFA were 2.09 (95% confidence interval = (1.01, 4.32)) times more likely to be retreated once for BRD. Similarly, cattle treated for BRD after metaphylactic treatment with CCFA were 5.63 (95% confidence interval = (1.43, 22.19)) times more likely to be retreated twice for BRD. Antibiotic cost was $5.61/calf lower in the TIL group compared to calves in the CCFA group ($P \leq 0.05$). Based on these results, metaphylactic treatment with TIL was more cost-effective and efficacious in reducing subsequent antibiotic treatments than CCFA.

Key words: bovine respiratory disease, ceftiofur crystalline free acid, metaphylaxis, tilmicosin phosphate

Résumé

On a comparé l'efficacité d'une simple dose en métaphylaxie d'une suspension stérile de ceftiofur cristalline sous forme acide (CCFA) ou de phosphate de tilmicosine (TIL) sur la performance et la santé animale chez des veaux à l'arrivée qui sont à risque pour le complexe respiratoire bovin (CRB). Des taurillons (n = 39) et des bouvillons (n = 264) de race croisée (poids initial = 464 ± 27.7 lb (211 ± 12.6 kg)) ont été reçus à trois dates différentes. Les veaux ont été stratifiés selon leur statut de castration et leur poids. Des enclos ont été alloués au hasard à des groupes de traitement recevant une simple dose de CCFA ou de TIL en métaphylaxie. Le taux de morbidité (au moins un traitement pour le CRB) était de 19.9% dans le groupe CCFA et de 15.1% dans le groupe TIL, une différence non-significative (P = 0.13). Les veaux traités pour le CRB après l'administration en métaphylaxie de CCFA avaient 2.09 fois plus de chance (intervalle de confiance à 95% = (1.01, 4.32)) d'être traités à nouveau une fois pour le CRB. De façon similaire, les bovins traités pour le CRB après l'administration en métaphylaxie de CCFA avaient 5.63 fois plus de chance (intervalle de confiance à 95% = (1.43, 22.19)) d'être traités à nouveau deux fois pour le CRB. Par rapport au groupe CCFA, il y avait une réduction du coût des antibiotiques de 5.61$ par veau dans le groupe TIL (P < 0.05). En se fondant sur ces résultats, le traitement avec TIL en métaphylaxie était plus rentable que le traitement avec CCFA et nécessitait moins d'antibiothérapie par la suite.

Introduction

Bovine respiratory disease (BRD) causes significant economic and production losses in the beef cattle industry.[13] Calves considered at high risk to develop BRD frequently receive immunizations and metaphylactic antimicrobial therapy to mitigate this risk.[4,13] Metaphylactic treatment can significantly reduce negative health effects and decreased feeding performance often seen in cattle stricken with BRD.[8] The objective of this study was to compare the effect of a single metaphylactic dose of ceftiofur crystalline free acid[a] (CCFA) to a single dose of tilmicosin phosphate[b] (TIL) on performance and health of newly received calves at risk for BRD.

Materials and Methods

All animal use, handling, and sampling techniques described herein were approved by the University of Arkansas Animal Care and Use Committee.

Animals, Treatment Allocation, and Processing

Animals. A total of 303 crossbred bull (n = 39) and steer (n = 264) calves (initial body weight (BW) = 464 ± 27.7 lb (211 ± 12.6 kg)) were purchased from livestock auctions in Florida and transported to the University of Arkansas Agricultural Experiment Station (Receiving Unit) located near Savoy. Cattle were received on 3 dates in 1 truckload/date (Table 1). For each date block, 8 pens (4 pens/treatment) were used; therefore, each treatment was replicated a total of 12 times.

Treatment allocation. On arrival (day -1), cattle were weighed (unshrunk), assigned a unique ear identification tag, and arrival castrate status (bull or steer) was determined. Calves remained commingled overnight, with access to hay and water. The following day (day 0), bulls and steers were stratified by castrate status and weight. Castrate status was equally distributed to treatments by assigning a similar number of bull and steer calves to each treatment pen (8 pens/block). Pens were then assigned randomly to single-dose antimicrobial metaphylaxis: 1) CCFA (3 mg/lb; 6.6 mg/kg BW) administered subcutaneously (SC) in the middle one-third of the posterior aspect of the ear or 2) TIL (6 mg/lb; 13.3 mg/kg BW) administered SC in the neck. Recommended site, method, and route of injection administration were performed according to the manufacture's information leaflet.

Processing. In addition to receiving their assigned metaphylactic antimicrobial therapy on day 0, calves were treated for internal parasites with 1 mL/100 lb (1 mL/45.5 kg) BW ivermectin,[c] and administered a pentavalent modified-live virus respiratory vaccine[d] and a multivalent clostridial bacterin-toxoid.[e] Calves were implanted,[f] branded with a hot iron on the right hip, and ear-notched to test for the presence of cattle persistently infected with bovine viral diarrhea virus using the antigen-capture ELISA (ACE)[g] method at a commercial laboratory.[h] All calves tested negative for the virus. Bull calves were castrated by banding.[i] Horn tipping was not performed, and no attempt was made to equalize the number of horned calves. On day 14, calves were revaccinated with the same brand of pentavalent modified-live virus respiratory vaccine used at initial processing.

Routine Feeding Procedures

Following processing, cattle were moved to their assigned 1.11 acre (0.45-ha) pens and provided 2 lb (0.9 kg)/calf (as-fed basis) of a receiving supplement (15.5% crude protein, dry matter (DM) basis; Table 2) and free-choice access to bermudagrass hay (15.4% crude protein, 37.5% acid detergent fiber, 72.5% neutral detergent fiber, and 8.7% ash, DM basis). Supplement was offered daily at 8:00 a.m., and was increased to a maximum of 4 lb (1.8 kg)/calf daily as calves' appetite increased.

Body weights were collected for calves in each block at the beginning and end of the study on 2 consecutive days prior to supplement feeding. Interim BW were collected prior to feeding of supplement on day 17 and 31 (block I), day 18 and 32 (block II), and day 17 and 31 (block III). Average daily gain (ADG) was calculated for interim and final periods based on averages of initial and final BW that were taken on 2 consecutive days. Grab samples of supplement were taken daily and composited within block. Grab samples of hay were taken from each bale offered and were composited within block. Samples were frozen at -4 °F (-20 °C) until analysis. Samples of supplements and hay were dried at 122 °F (50 °C) in a forced-air oven until a constant weight to determine DM. Composited supplement and hay samples were ground to pass a 1-mm screen in a Wiley mill and analyzed for ash, DM, crude protein by the rapid combustion procedure, and acid and neutral detergent fiber by batch procedures using the ANKOM^{200} Fiber Analyzer[j] in the University of Arkansas Ruminant Nutrition Laboratory.

Assessment, Treatment, and Removal of Morbid Cattle

Assessment. After arrival metaphylaxis, a 72-hour post-treatment interval (PTI) was implemented; therefore, calves were observed each morning (8:00 a.m.) beginning on day 4 of the study for clinical signs of BRD by 2 Receiving Unit personnel having a combined 35-years' experience evaluating cattle at risk of BRD. These personnel were present during processing and were not blinded to treatment; however, no records left at the facility identified treatment

Table 1. Design attributes for blocks evaluating antimicrobial metaphylaxis efficacy.

Attribute	Block I	Block II	Block III
Start date	14-September-2012	02-November-2012	12-January-2013
End date	29-October-2012	18-December-2012	27-February-2013
Study length, d	45	47	46
Total no. calves	108	99	96
Bulls	1	22	16
Steers	107	77	80
Replicates*	4	4	4
Calves/pen	13 or 14	12 or 13	12

*Pens fed/treatment.

assignments. Calves displaying various signs of BRD (Table 3), or any combination of these, were removed from pens for further evaluation. These animals were weighed and rectal temperature (RT) evaluated via digital thermometer.[k] To be considered "a case" of BRD, calves had to meet 1 of the 2 following definitions based on presenting clinical signs: 1) clinical impression score (CIS) ≥ 1 and a RT of ≥ 104.0 °F (40.0 °C), or 2) CIS ≥ 2 regardless of RT.

Treatment. All calves that met the treatment criteria for BRD were treated with enrofloxacin (5.6 mg/lb; 12.5 mg/kg BW SC).[l] A 48-hour PTI was observed following administration of enrofloxacin, and the RT was recorded for all calves upon expiration of the initial antibiotic PTI. If the RT was ≥ 104.0 °F (40.0 °C), the calf was administered florfenicol (18 mg/lb; 40 mg/kg BW SC).[m] A 96-hour PTI was observed for cattle administered florfenicol, and RT was evaluated upon expiration of the PTI for the second antibiotic. If the RT was ≥ 104.0 °F (40.0 °C), the calf was administered oxytetracycline at 9.9 mg/lb (22 mg/kg) BW SC.[n] A 48-hour PTI was followed for cattle administered oxytetracycline, and RT was taken upon expiration of the PTI. Cattle that continued to show clinical signs of BRD after the third treatment were considered chronically ill, and no further antibiotic treatment was administered. If at any time a re-check RT was < 104.0 °F (40.0 °C) the animal was left untreated unless further clinical signs developed. Clinical BRD in calves 21 days or more after administration of previous BRD therapy was considered a new episode. Morbidity data recorded included treatment date, RT at the time of therapeutic treatment, CIS, incidence of first, second, or third respiratory treatment, the dose and type of antibiotic administered, and mortality rates. After treatment for BRD, cattle were returned to their home pen. At the conclusion of the study, healthy cattle were transported to a feedlot.

Cattle classified as chronically ill were withheld from the market until the labeled antibiotic withdrawal period had passed, and they no longer exhibited clinical signs of BRD. Cattle meeting these criteria were sold through local livestock auctions.

Removal. In block III, 1 calf from the TIL group was euthanized, and was transported to the University of Arkansas Veterinary Diagnostic Laboratory for necropsy. Necropsy found severe, subacute, necrosuppurative myositis and mild vascular necrosis. A myriad of unidentified bacteria were observed in muscle samples submitted for histological examination. This animal was included in the final data analysis. No calves in the study died of BRD.

Table 2. Composition of supplement.

Ingredient, %*†	
Corn grain, cracked	68.4
Dried distillers' grains	26
Limestone	2
Molasses	2
Salt	1
Vitamin A, D, and E‡	0.1
Vitamin E premix‖	0.05
Rumensin premix§	0.4
Trace mineral premix¶	0.085

*Ingredients reported on an as-fed basis.
†Fed at a rate of 4 lb (1.8 kg)/day to cattle grazing mixed-grass pasture and also offered ad libitum access to bermudagrass hay.
‡Provided when fed at 4 lb (1.8 kg)/day: 77,760 IU vitamin A; 15,560 IU vitamin D; and 9 IU vitamin E.
‖Provided 390 IU Vitamin E when fed at 4 lb (1.8 kg)/day.
§Rumensin 80 (Elanco Animal Health, Greenfield, IN) provided 88 mg of monensin/day when fed at 4 lb (1.8 kg)/day.
¶Provided when fed at 4 lb (1.8 kg)/day: 4.4 mg cobalt; 353 mg copper; 17.6 mg iodine; 89 mg iron; 704 mg manganese; 5.3 mg selenium; and 1,058 mg zinc (Nutrablend, Neosho, MO).

Statistical Analyses

Performance data. Performance data were analyzed using the MIXED procedure of SAS.[o] Adherence of the data to the assumptions of the statistical test was established. Body weight data were analyzed as repeated measures. The fixed (main) effects in the model included treatment and day, as well as the 2-way interaction, whereas block was included in the model as a random effect. Initial BW was included as a covariate in the analysis. The model for ADG included treatment as a fixed effect, whereas block was included in the model as a random effect. Data were tested using a compound symmetry (CS) covariance structure and degrees of freedom for the pooled error term were calculated using

Table 3. Scoring system used to diagnose bovine respiratory disease in calves.

Clinical impression score	Diagnosis	Clinical signs
0	Normal	No abnormal clinical signs.
1	Slightly ill	Mildly abnormal character of respiration. Dyspnea may be combined with some depression, gauntness, nasal and/or ocular discharges. Hair coat may be rough.
2	Moderately ill	Moderately abnormal character of respiration. Noticeable dyspnea, depression, gauntness, nasal and/or ocular discharges. Hair coat may be rough.
3	Severely ill	Severely abnormal character of respiration. Noticeable dyspnea, depression, gauntness, nasal and/or ocular discharges. Hair coat may be rough.
4	Morbid	Down and at the point of death. Mouth breathing.

Kenward-Roger's approximation. Pen was the experimental unit. Least squares means were partitioned at the 5% level of significance by means of the probability of differences (PDIFF) option. Statistical significance was declared at $P < 0.05$; tendencies were declared at $0.05 \geq P < 0.10$.

Health data. Binary morbidity response variables (morbidity, treated with first retreatment, second retreatment, and chronic; coded as 1 for yes responses and 0 for no responses) were analyzed using the GLIMMIX procedure of SAS. The fixed effect in the model included treatment, whereas block and an over dispersion parameter were included in the model as random effects. Binary data were tested using a binomial distribution, logit link function, and variance components (VC) covariance structure. Calf was the experimental unit. Continuous morbidity response variables (day first treated, RT at first retreatment, RT 48 hours after treatment, day second retreated, treatments/calf, metaphylaxis cost, BRD treatment cost, and total cost/calf) were analyzed using the MIXED procedure of SAS. Adherence of the data to the assumptions of the statistical test was established. The fixed effect in the model included treatment, whereas block was included in the model as a random effect. Data were tested using a VC covariance structure, and degrees of freedom for the pooled error term were calculated using Kenward-Roger's approximation. Calf was the experimental unit. Least squares means were partitioned at the 5% level of significance by means of the PDIFF option. Statistical significance was declared at $P < 0.05$; tendencies were declared at $0.05 \geq P < 0.10$.

Table 4. LSMEANS‡ for effects of metaphylaxis at arrival processing on performance.

	Metaphylactic treatment			
Item	**CCFA***	**TIL†**	**SEM**	***P*-value**
Initial BW,‡ lb	465	465	14.05	0.85
Final BW,‡ lb	588	590	14.05	0.50
ADG, lb/d				
d 0 to 14	3.26	3.15	0.13	0.52
d 15 to 28	2.07	2.42	0.20	0.23
d 29 to 46	2.38	2.38	0.09	0.96
d 0 to 46	2.64	2.71	0.09	0.56

*Ceftiofur crystalline free acid (CCFA; Excede, 3 mg/lb (6.6 mg/kg) body weight, Zoetis, Florham Park, NJ).
†Tilmicosin phosphate (TIL; Micotil, 6 mg/lb (13.3 mg/kg) body weight, Elanco Animal Health, Greenfield, IN).
‡Analyses conducted by using body weight (BW) on day 0 as a covariate.

Results and Discussion

Performance data. No differences ($P \geq 0.23$) in ADG were observed between metaphylactic treatments (Table 4). Results of metaphylactic treatment on gain are varied. A study conducted at 9 feedlots showed cattle receiving TIL (4.5 mg/lb (10 mg/kg) BW) on arrival had similar ADG at day 29 compared to calves treated with CCFA (3 mg/lb (6.6 mg/kg) BW) on arrival, 3.47 and 3.51 lb/day (1.56 and 1.58 kg/day), respectively.[5] Likewise, a study conducted at 2 sites with higher-risk stocker calves also found cattle receiving TIL (4.5 mg/lb (10 mg/kg) BW) on arrival had comparable ADG at day 80 at site A and day 60 at site B when compared to those receiving CCFA (3 mg/lb (6.6 mg/kg) BW) on arrival (site A: 2.47 and 2.44 lb/day (1.11 and 1.10 kg/day), respectively; site B: 2.49 and 2.44 lb/day (1.12 and 1.10 kg/day), respectively).[12] Conversely, results of this study are inconsistent with a *Mannheimia haemolytica* challenge model study conducted in 6 research and commercial feedlots that reported cattle receiving TIL (4.5 mg/lb (10 mg/kg) BW) on arrival had greater ($P < 0.05$) ADG at day 57 compared to those receiving CCFA (3 mg/lb (6.6 mg/kg) BW) on arrival (3.09 and 2.98 lb/day (1.39 and 1.34 kg/day), respectively).[6]

Health data. A negative control or nonmedicated group of calves (i.e., no antimicrobial metaphylaxis administered on arrival) was not included in the study design; therefore, it was not possible to determine a morbidity baseline. As shown in Table 5, none (0 of 108) of the calves in block I were treated for BRD, whereas 60.6% (60 of 99) in block II and 85.4% (82 of 96) in block III were not treated. Dissimilar weather experienced by the blocks of calves may partially explain the varied morbidity between blocks. Weather has been implicated as a contributor to BRD, likely because morbidity due to BRD is greater in the fall. However, this also

Table 5. Summary of morbidity and retreatment data for bovine respiratory disease (BRD) in calves receiving metaphylaxis by block.

	Block I		Block II		Block III	
	CCFA*	**TIL†**	**CCFA**	**TIL**	**CCFA**	**TIL**
No. calves	54	54	49	50	48	48
Morbidity, %	0.0	0.0	49.0	30.0	12.5	16.7
First retreat,‡ %	0.0	0.0	66.7	40.0	33.3	50.0
Second retreat,§ %	0.0	0.0	50.0	16.7	100.0	25.0
BRD mortality, %	0.0	0.0	0.0	0.0	0.0	0.0

*Ceftiofur crystalline free acid (CCFA; Excede, 3 mg/lb (6.6 mg/kg) body weight, Zoetis, Florham Park, NJ).
†Tilmicosin phosphate (TIL; Micotil, 6 mg/lb (13.3 mg/kg) body weight, Elanco Animal Health, Greenfield, IN).
‡Number of animals treated for first BRD relapse divided by the number of animals treated for initial BRD.
§Number of animals treated for second BRD relapse divided by the number of animals treated for first BRD relapse.

Table 6. Summary of morbidity and retreatment data for bovine respiratory disease (BRD) in calves receiving metaphylaxis at arrival processing.

	Metaphylactic treatment		
Item	**CCFA***	**TIL†**	***P*-value**
No. calves	151	152	
Morbidity,‡ %	19.9	15.1	0.13
First retreat,§ %	60.0	43.4	0.05
Second retreat,‖ %	55.6	20.0	0.01
Chronic,¶# %	0.7	1.3	0.55
BRD mortality, %	0.0	0.0	1.00

*Ceftiofur crystalline free acid (CCFA; Excede, 3 mg/lb (6.6 mg/kg) body weight, Zoetis, Florham Park, NJ).
†Tilmicosin phosphate (TIL; Micotil, 6 mg/lb (13.3 mg/kg) body weight, Elanco Animal Health, Greenfield, IN).
‡Percentage of total calves in study.
§Number of animals treated for first BRD relapse divided by the number of animals treated for initial BRD.
‖Number of animals treated for second BRD relapse divided by the number of animals treated for first BRD relapse.
¶Data retained in statistical analyses.
#Number of animals classified as chronically ill divided by the number of animals allocated.

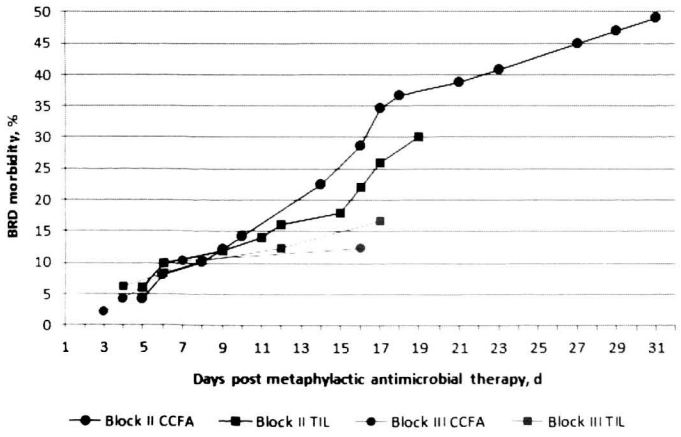

Figure 1. Cumulative percentage of calves treated for bovine respiratory disease (BRD) after receiving single-dose metaphylaxis with ceftiofur crystalline free acid (CCFA; Excede, 3 mg/lb (6.6 mg/kg) body weight), or tilmicosin phosphate (TIL; Micotil, 6 mg/lb (13.3 mg/kg) body weight) for BRD, by treatment and days post-metaphylactic therapy (day, $P < 0.05$). Excludes block I cattle, as no calves in this block developed BRD.

corresponds with the greatest commingling and transport of calves. In this study, calves from the 3 blocks were of similar quality and experienced similar levels of commingling and transportation; however, calves in the 3 blocks experienced differing daily temperatures. Analysis of feedlot operational data from 9 US commercial feedlots (288,388 cattle total) during September to November in 2005 to 2007, attributed temperature change to an increased occurrence of BRD.[2] Moreover, a moderate correlation between minimum daily temperature and the occurrence of BRD has been observed.[3] In the current study, the absence of morbidity in block I could be attributed to these calves experiencing the least temperature change and the highest minimum daily temperature. An additional confounder that may have contributed to the varied morbidity between blocks is the presence of bulls that required castration. Calves that are bulls at the time of arrival are 3.32 times more likely to develop BRD when compared to male calves that arrive as steers.[9] Accordingly, the varied morbidity observed between blocks could also be attributed to the disproportionate number of bulls between blocks, but the exact reason(s) for the morbidity differences is not known.

Morbidity (calves treated at least once for BRD) rates were 19.9 and 15.1% ($P = 0.13$; Table 6 and Figure 1) for calves in the CCFA and TIL groups, respectively. Calves treated for clinical BRD after metaphylactic treatment with CCFA were 2.09 (95% confidence interval = (1.01, 4.32)) times more likely to be retreated once for BRD. Similarly, cattle treated for BRD after metaphylactic treatment with CCFA were 5.63 (95% confidence interval = (1.43, 22.19)) times more likely to be retreated twice for BRD. There was a trend ($P = 0.10$; Table 7) for metaphylaxis to impact the days to treatment of the first BRD episode. The average days from arrival until treatment for BRD was 14.1 days for calves in the CCFA group compared to 10.9 days for calves in the TIL group. Similarly, metaphylaxis impacted ($P = 0.05$) the days to first retreatment. Average days from arrival until first re-treatment for BRD was 19.3 days for calves in the CCFA group compared to 12.3 days for calves treated with TIL at arrival processing. Metaphylaxis did not affect RT at treatment ($P \geq 0.25$). The lower morbidity in calves in the TIL group tended to be associated with fewer total ($P = 0.07$) antibiotic treatments/calf, and the total antibiotic cost was \$5.61/calf ($P \leq 0.05$) lower in the TIL group.

Results of this study are not consistent with some earlier metaphylaxis studies in high-risk stocker and feedlot calves. In the aforementioned study conducted at 9 feedlots, morbidity was similar for cattle receiving TIL or CCFA on arrival (25.1 and 28.2%, respectively).[5] However, consistent with the current study, the number of days to onset of BRD was longer ($P < 0.001$) for cattle receiving CCFA compared to those receiving TIL, 6.7 and 5.7 days, respectively. In another

Table 7. Effects of metaphylaxis at arrival processing on calf health and cost of bovine respiratory disease (BRD) therapy.

Item	Metaphylactic treatment		SEM	*P*-value
	CCFA*	TIL†		
Day first treated	14.1	10.9	1.36	0.10
Rectal temperature at treatment, °F	104.9	105.1	0.22	0.89
Rectal temperature 48 hours after treatment, °F	103.3	103.5	0.22	0.25
Day first retreated	19.3	12.3	2.38	0.05
Treatments/calf‡	0.38	0.23	0.06	0.07
Metaphylaxis cost, $ §	13.19	12.56	0.08	< 0.0001
BRD treatment cost/calf, $ ‖	23.83	19.09	1.68	0.05
Total cost/calf, $ ¶	37.49	31.88	1.72	0.03

*Ceftiofur crystalline free acid (CCFA; Excede, 3 mg/lb (6.6 mg/kg) body weight, Zoetis, Florham Park, NJ).
†Tilmicosin phosphate (TIL; Micotil, 6 mg/lb (13.3 mg/kg) body weight, Elanco Animal Health, Greenfield, IN).
‡Number of antibiotic treatments administered/calf.
§Metaphylaxis cost assuming a value of $1.90/mL for CCFA and $1.36/mL for TIL.
‖Treatment cost for BRD assuming a value of $0.50/mL for enrofloxacin (Baytril, Bayer Animal Health, Shawnee Mission, KS), $0.52/mL for florfenicol (Nuflor, Merck Animal Health, Summit, NJ), and $0.09/mL for long-acting tetracycline (Biomycin 200, Boehringer Ingelheim Vetmedica Inc., St. Joseph, MO).
¶Sum of the metaphylaxis cost and treatment cost/hd for calves treated for BRD.

study conducted with stocker calves at 2 sites there were no significant differences in morbidity at either site A ($P = 0.73$) or site B ($P = 0.62$) between calves treated metaphylactically with either TIL or CCFA (site A: 76.3 and 78.4%, respectively; site B: 9.4 and 7.2%, respectively).[12] A *M. haemolytica* challenge study demonstrated that a single dose of TIL on arrival provided similar efficacy against BRD compared to a single dose of CCFA through day 57 (36.5 and 40.4% morbidity, respectively).[6] A similar *M. haemolytica* challenge model study showed that calves treated with CCFA (3 mg/lb (6.6 mg/kg) BW) on arrival had a lower ($P < 0.05$) mean RT through 3 days post-challenge compared to calves treated metaphylactically with TIL (4.5 mg/lb (10 mg/kg) BW) on arrival.[7,11]

The seemingly paradoxical differences in performance and health outcomes between metaphylaxis studies could be attributed to the diagnostic criteria used to identify animals suffering from BRD. In the present study calves had to meet 1 of 2 criteria based on presenting clinical signs to be treated for BRD: CIS ≥ 1 and a RT of ≥ 104.0 °F (40.0 °C) or CIS ≥ 2 regardless of RT. Alternatively, the following diagnostic criteria have been employed: 1) clinical attitude score of 1 or 2 and a RT of ≥ 104.0 °F (40.0 °C) or a clinical attitude score of 3 or 4 regardless of RT;[12] 2) visual signs of BRD and RT of ≥ 105.0 °F (40.5 °C);[1] and 3) ≥ 2 visual signs of BRD and RT of ≥ 104.0 °F (40.0 °C).[10] Bovine respiratory disease diagnostic criteria is notably variable. Accordingly, there is potential for performance and health disparities between studies. Similarly, disparities in performance and health outcomes between metaphylaxis studies could be attributed to differences in antimicrobial susceptibility of bacterial pathogens implicated in BRD. Cattle selected for the current study were from Florida, whereas cattle used in previous studies were primarily from the Great Plains.[5,12] Accordingly, there is the potential for geographical bias in antimicrobial susceptibility among BRD pathogens. Analyses of human clinical isolates have shown strong regional distribution patterns of antimicrobial susceptibility phenotypes.[14] Moreover, the susceptibility of BRD pathogens in the current study may not represent the susceptibility of BRD pathogens of previous studies, as the current study did not submit samples for bacterial culture and antimicrobial susceptibility testing.

Conclusions

When the efficacy of single-dose metaphylactic treatment with CCFA and TIL in high-risk calves was compared, TIL was more cost-effective and efficacious in reducing morbidity and subsequent retreatments. Metaphylactic treatment with TIL tended to result in fewer antibiotic treatments/calf and decreased total antibiotic costs by $5.61/calf. Management strategies that mitigate pathogen, environmental, and nutritional stressors remain critical to reducing the incidence of BRD.

Endnotes

[a]Excede, Zoetis, Florham Park, NJ
[b]Micotil, Elanco Animal Health, Indianapolis, IN
[c]Ivomec Plus, Merial Limited, Duluth, GA
[d]Pyramid 5, Boehringer Ingelheim Vetmedica, St. Joseph, MO
[e]Covexin 8, Merck Animal Health, Summit, NJ
[f]Component TE-G with Tylan, Elanco Animal Health, Indianapolis, IN
[g]Idexx Laboratories, Inc., Westbrook, ME
[h]Cattle Stats, LLC, Oklahoma City, OK
[i]California Bander, InoSol Co. LLC, El Centro, CA

[j]ANKOM Technology Corp., Fairport, NY
[k]Model No. M216, GLA Agricultural Electronics, San Louis Obispo, CA
[l]Baytril, Bayer Animal Health, Shawnee Mission, KS
[m]Nuflor, Merck Animal Health, Summit, NJ
[n]Biomycin 200, Boehringer Ingelheim Vetmedica Inc., St. Joseph, MO
[o]SAS Inst. Inc., Cary, NC, version 9.2

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