Using thoracic ultrasonography to investigate the impact of antibiotic therapy on the health and performance of preweaned dairy calves

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Introduction:

Bovine respiratory disease (BRD) continues to be a major cause of morbidity and mortality of preweaned dairy calves. Costs associated with this condition include drug and labor costs as well as loss of animal productivity. Recent use of clinical scoring systems and thoracic ultrasonography allows for the diagnosis of different BRD subtypes including upper respiratory tract infection, clinical pneumonia, and subclinical pneumonia (Ollivett and Buczinski, 2016). Previously, the impact of antibiotic therapy has not been evaluated on these different BRD subtypes. Therefore, the objective of this study was to determine the impact of antibiotic therapy on the health and performance of preweaned dairy calves affected by different BRD subtypes.

Materials and Methods:

Calves were enrolled at two commercial dairy farms in southern Wisconsin, USA for this randomized, placebo-controlled clinical trial. Animals were housed individually for the first week of life then moved to group housing and fed either milk replacer or pasteurized whole milk via automated feeders. A total of 292 preweaned Holstein calves were followed for 52 days. Calves were evaluated for BRD twice weekly using the University of Wisconsin Calf Health Scorer iPad App where they were assigned a clinical respiratory score (CRS) and ultrasonographic lung score (USS) at each visit. Calves were blocked by BRD subtype and randomized to receive antibiotic (TX; tulathromycin, 2.5 mg/kg, SQ) or placebo (CN; equal volume of sterile saline) at their first BRD event (BRD1). All research staff involved in thoracic ultrasound and clinical scoring were blinded to treatment group. The BRD1 subtypes included: upper respiratory tract infection (URTI: USS-, CHS+), subclinical pneumonia (SP: USS+, CHS-), and clinical pneumonia (CP: USS+, CHS+). Treatment failure was defined as receiving treatment for a second time within seven days of BRD1. The outcomes of interest included the proportion of calves with lung score progression, treatment failure, and average daily gain (ADG). All analyses were completed in SAS statistical software (version 9.4). Differences between categorical outcomes including lung score progression and treatment failure were assessed by the chi square test in the FREQ procedure. A multivariable linear regression model was fit for ADG using the MIXED procedure and backward elimination of covariates. Herd, treatment group, passive transfer status, calf sex, and BRD1 subtype were retained in the final model. No

significant interactions between treatment group and the remaining covariates were found. Treatment group was considered the primary predictor of interest. BRD1 subtype was forced into the model to provide estimates. Significance was set at $\alpha < 0.05$ for all comparisons.

Results:

Fewer TX calves had ultrasonographic lung lesion progression compared to CN calves by their next exam (24% vs 38%, respectively; $P = 0.01$). Treatment did not affect the proportion of calves with ultrasonographic improvement in lung lesions (34% vs 27%, respectively; $P = 0.25$). However, antibiotic therapy did reduce the proportion of calves requiring retreatment compared to CN (22% vs 48%, respectively; $P < 0.0001$). The ADG (kg ± SE) in TX calves was 0.73 ± 0.02 kg/day compared to 0.68 ± 0.02 kg/day in CN calves ($P = 0.01$). The ADG for URTI, SP, and CP was 0.72 ± 0.02 kg/day, 0.72 ± 0.02 kg/day, and 0.67 ± 0.02 kg/day, respectively ($P = 0.20$).

Significance:

This is the first study to demonstrate that early antibiotic therapy can limit the progression of ultrasonographic lung lesions associated with BRD, despite an absence of substantial improvement during the short term period after treatment. Performing thoracic ultrasonography may help veterinarians diagnose BRD early, when treatment is most likely to be successful. Understanding how the lung responds to antibiotic treatment will allow veterinarians to target antibiotic therapy towards calves who may show the greatest benefit.