Sequential analysis of bovine respiratory disease diagnosis with thoracic ultrasonography and clinical signs in pre-weaned dairy calves

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Introduction

Bovine respiratory disease (BRD) impacts dairy profitability and animal welfare. Historically, diagnosis and treatment have been based on clinical assessments. Thoracic ultrasonography (TUS) offers a supplemental diagnostic tool for BRD with purported enhanced sensitivity (Se) and specificity (Sp). This study investigated the quality of clinical diagnostic performance relative to TUS throughout BRD progression. It further aimed to investigate the association between on-farm antimicrobial treatments and the onset or improvement of TUS lesions.

Materials and methods

Thirty Holstein dairy heifers (18-25 d old) were enrolled per dairy on 2 dairies in central Washington in June 2021. On-farm treatment records were collected and calves were assessed weekly to 11 wks of age for clinical respiratory signs and lobar consolidation via TUS. Calves were considered positive for TUS lesions if at least one of the 7 lobes was consolidated. The Wisconsin Calf Health Scoring Chart was used to score clinical signs (CS) in calves. CS were summed and considered positive for BRD if ≥ 4. Calves were categorized weekly as non-diseased (Healthy or Recovered) or diseased (Pre-, Onset or Chronic consolidation) based on the sequence of TUS findings. Receiver Operating Characteristic curves with area under the curve (AUC), Cohen's Kappa tests, Se and Sp compared the presence of clinical BRD vs category of diseased calves using TUS as a gold standard qualifier and the sum of CS as the unknown qualifier. A Cohen's Kappa test, Se and Sp were also calculated for on-farm treatments to determine agreement with TUS lesions.

Results

Results indicated that lobar consolidation at Onset had the strongest alignment with CS. There was a 77% likelihood that CS would be present at the onset of TUS lesions (AUC = 0.77), indicative of fair agreement (Kappa = 0.33) between CS and TUS findings. CS were 67% likely to be present in the week Pre-consolidation, indicative of only slight agreement (AUC = 0.67, Kappa = 0.07) with subsequent TUS lesions. CS in cases of Chronic Consolidation were 66% likely to be present the weeks following the Onset of consolidation, which was also indicative of only slight agreement (AUC = 0.66, Kappa = 0.18) with ongoing TUS lesions. The Se and Sp of CS to detect BRD based on TUS lesions differed based on the timing of disease. Pre-consolidation CS demonstrated 11% Se and 93% Sp. CS at the Onset of consolidation demonstrated 35% Se and 96% Sp. Post-consolidation CS demonstrated 18% Se and 96% Sp. These findings indicate the limitations for using CS for preventive treatment or evaluations of treatment success. Of the calves that were treated for BRD, 47% (8/17) were treated at or after the onset of lobar consolidation. On-farm treatments had only slight agreement with TUS lesions (Kappa = 0.04) with a resultant Se and Sp of 31% and 71%, respectively. Overall, 88% (23/26) of calves with TUS lesions showed improvement over the study period with a least 1 lobe that was consolidated becoming unconsolidated by the end of the study. Additionally, 58% (14/26) of those diseased calves fully recovered in that they had consolidation in at least 1 lobe during the study period and had no fully consolidated lobes by the end of the study. Of the TUS improved calves, 30% (7/23) were treated with antimicrobials at some point during the study and of the recovered calves, 21% (3/14) were treated.

Significance

Sequential assessment of TUS lesions, CS and on-farm treatment records indicated that TUS could provide a more robust assessment of BRD than CS alone and inform producers of lesions that cannot be clinically identified. This might offer further insight into improving BRD diagnoses, therapeutic choices, retreatment options or culling decisions. This study also found that many TUS lesions will improve with or without treatment suggesting that further investigations are warranted to determine the utility of TUS for directing BRD management protocols including the initiation of antimicrobial therapy.

