

# Use of thoracic ultrasonography for the evaluation of lung pathology in beef cattle with acute bovine respiratory disease

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## Introduction

Bovine respiratory disease (BRD) is the most economically important disease of feedlot cattle. To enhance management of individual feedlot cattle with BRD there is a need to better determine the extent and duration of lung pathology on a real-time basis. Development of an objective ultrasound (U/S) scoring system that allows for better interpretation of the disease pathogenesis may improve individual case management. Although the peer-reviewed literature contains multiple reports on the use of thoracic U/S for the evaluation of BRD in dairy cattle, reports of its use in feedlot cattle are limited. The purpose of this study was to describe the use of thoracic U/S for the evaluation of BRD in feedlot cattle.

## Materials and Methods

During the summer of 2012, 3 loads of high-risk beef steers ( $n = 232$ ) were purchased from auction markets in California and shipped to a research feedlot in Parma, Idaho. Steers with clinical signs consistent with BRD and a rectal temperature  $\geq 104.0^{\circ}\text{F}$  ( $40^{\circ}\text{C}$ ) were enrolled in a cohort study. For every 2 steers with BRD that were enrolled in the study, one asymptomatic control steer was also enrolled. Clinical observation and thoracic U/S examination were performed on all study steers at (0 hour) and 72, 144, and 216 hours, and 15 days after enrollment. Steers with BRD were not administered any treatment prior to day 15 so that the natural progression of BRD could be observed.

An IBEX Pro ultrasound machine with an 8.5 MHz linear 66-mm transducer (EI Medical Imaging, Loveland, CO) was used to perform each thoracic U/S examination, which consisted of 46 locations per steer (23 per side) that encompassed a region from the 4th to 10th intercostal spaces. A 4-second loop of U/S video was obtained at each location and evaluated later for 7 different criteria associated with lung pathology. Tabulated values were then used to calculate the number of comet tails (TAIL), number of sites with pleural irregularities (PIRR), maximal depth of pleural effusion (PLEEF), maximal depth of consolidation (DEPTH), maximal area of consolidation (AREA), and total area of consolidation

(TCA). Data were analyzed with commercially available software (SAS 9.2, Cary, NC and MedCalc, v.12.4.0 Mariakerke, Belgium).

## Results

The study population consisted of 29 steers with BRD (cases) and 15 control steers. At the initial U/S examination (hour 0), cases had significantly greater median values for PIRR, DEPTH, AREA, and TCA (4 locations, 5.0 cm, 17.0 cm<sup>2</sup>, and 28.0 cm<sup>2</sup>, respectively) than did controls (1 location, 0.0 cm, 0.0 cm<sup>2</sup> and 0.0 cm<sup>2</sup>, respectively). Of the 29 cases, 12 did not survive the entire 15-day observation period and had significantly greater median values for PIRR, DEPTH, AREA, and TCA (7.5 locations, 7.5 cm, 34.0 cm<sup>2</sup>, and 75.0 cm<sup>2</sup>, respectively) than did survivors (3 locations, 4.5 cm, 15.0 cm<sup>2</sup>, and 21.0 cm<sup>2</sup>, respectively). Median values for TAIL and PLEEF were not significantly correlated between cases and controls or between cases that did and did not survive for 15 days after enrollment. Further analyses were performed to determine whether the presence of consolidation in certain sites was more predictive of case outcome than others, and 9 of 46 sites had an odds ratio significantly greater than 1.0.

## Significance

Study findings indicated that there was a high degree of positive correlation between clinical diagnosis of BRD and the presence and extent of pathology visualized by thoracic U/S, and negative correlation between clinical outcome of cases and extent of consolidation observed during initial thoracic U/S examination. Findings also indicated that certain locations of the thorax have greater prognostic value for predicting clinical outcome than do other locations, and limiting the thoracic U/S examination to those locations will reduce the time required to perform the exam. Thus, thoracic U/S warrants further investigation as a practical modality for evaluating disease severity and prognosis in feedlot cattle with BRD.