On-Farm Use of Ultrasonography for Bovine Respiratory Disease

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KEYWORDS

• Calf pneumonia • Thoracic ultrasonography • Diagnostic tests • Consolidation
• Lung lesions • Ultrasonography scoring • BRD subtypes

KEY POINTS

- The portable rectal ultrasonography machines used by bovine veterinarians for reproductive examinations are a fast, accurate, and practical means of diagnosing the lung lesions associated with bovine respiratory disease (BRD) in young cattle.
- When combined with respiratory scoring, thoracic ultrasonography (TUS) allows the differentiation of the following subtypes of BRD: upper respiratory tract disease, clinical pneumonia, and subclinical pneumonia; all of which can be performance limiting.
- Poor prognostic indicators, including caudal lung lobe consolidation, lung abscessation, and lung necrosis, can be identified by TUS.
- TUS can be used at the herd level to identify specific populations at risk for developing BRD and to monitor the prevalence and severity of BRD over time, as well as any responses to management changes such as ventilation, vaccination, or changes in treatment protocols.
- A systematic TUS technique is imperative and must be based on anatomic and ultrasonographic landmarks.

INTRODUCTION

Clinical scoring systems have been developed over recent years to improve early and accurate detection of young cattle affected by bovine respiratory disease (BRD).[1,2] These systems are useful but fail to differentiate between upper and lower airway disease and do not identify calves with subclinical pneumonia. Radiography, computed tomography (CT), and ultrasonography (US) are noninvasive methods of diagnosing

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pneumonia antemortem. One retrospective study of 42 clinically ill adult dairy cows showed that the sensitivity (Se = 94%) of radiography was excellent, but specificity (Sp = 50%) was poor for identifying thoracic lesions compared with postmortem findings.[3] There was a high correlation (r = 0.94) between CT and postmortem levels of consolidation in young dairy calves after experimental infection with *Mannheimia haemolytica*.[4] However, radiography and CT are not practical for diagnosing pneumonia in large numbers of calves in a farm setting because of physical equipment constraints, expense, anesthetic requirements, and the potential for exposure to radiation. However, thoracic US (TUS) can be performed calf-side using portable, readily available machines without the fear of exposure to radiation.

This article reviews the existing relevant literature regarding TUS in young cattle, reviews the pertinent respiratory anatomy and systematic ultrasonographic examination with landmarks, and discusses practical on-farm applications for bovine practitioners.

ACCURACY OF THORACIC ULTRASONOGRAPHY IN YOUNG CATTLE

The pathophysiology of pneumonia is such that cellular infiltrates and cellular debris effectively displace air from the lung tissue,[5] resulting in nonaerated and/or consolidated lung lesions that are detectable by TUS. These lesions change the ultrasonographic character of the lung from that of a strong reflector with reverberation artifact to a homogeneous, hypoechoic structure similar to that of the liver[6] and allow the diagnosis of pneumonia regardless of the clinical state of the animal.[7,8]

Although diagnostic US has been available for more than 50 years, few studies were performed in dairy cattle during the first 20 years and none involved US of the lungs.[9] Since the early 1990s, more studies have focused on evaluating the accuracy of TUS for identifying the lung lesions associated with pneumonia. Three studies have purposefully calculated the diagnostic Se and Sp, whereas others have more generally correlated the association between TUS and postmortem examination.

The first study to assess TUS accuracy was performed using 18 Holstein-Friesian calves up to 5 months of age.[10] These calves had various stages of clinical bronchopneumonia, lung abscess, and/or pneumothorax, and were subjected to euthanasia because of the severity of the lung disease (n = 10) or polyarthritis (n = 8). The 12th intercostal space (ICS) to the third ICS were evaluated using a 7.5-MHz sector scanner and the location of each US lesion was documented by its location within the ICS relative to the surrounding bony landmarks (ie, hip, shoulder, and elbow). The lesions were then classified into 5 different categories based on the character and depth of the echogenic pattern: radiating artifacts, consolidations, fine-grained structure, medium-grained structure, and coarse-grained structure. A Se of 85% and Sp of 98% were reported after comparing results from TUS and gross postmortem examination. A 10-cm pulmonary abscess, a pneumothorax, and 1 case of interstitial pneumonia were not detected by TUS.[10]

More recently, we used bayesian analysis to estimate the sensitivity and specificity of TUS in 2 different commercial populations of preweaned Holstein calves.[11] BRD was highly prevalent in the Canadian population (n = 106) and of average prevalence in the second, American, population (n = 85). Landmarks used to complete the examination were as described previously.[10] However, instead of 5 categories of ultrasonographic lesions, calves were considered BRD positive when at least 1 cm of ultrasonographic consolidation was present. In addition, the TUS was performed using a portable, linear, 6.2-MHz rectal scanner instead of a higher frequency sector scanner. The estimated Se of TUS was 79.4% (bayesian credible intervals [BCI], 66.4–90.9) and the Sp was 93.9% (BCI, 88.0–97.6).