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The monster we don't see: subclinical BRD in beef cattle

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Abstract

Bovine respiratory disease (BRD) is the most expensive disease affecting United States cattle. Recently weaned calves are the focus of prevention and treatment research. Identifying affected cattle early in the course of BRD is difficult. Intervention during the early stages of BRD improves treatment outcomes; however, cattle as prey animals are excellent at hiding signs of disease, especially if the caregiver has not gained their trust. Depression, appetite loss, and changes in respiratory character are the principal signs used to identify BRD. Rectal temperatures from cattle pulled for treatment are a final measure of evaluation. Cattle suffering from subclinical BRD frequently escape identification and treatment. Observations of lungs at packing plants for anterior ventral (AV) lesions frequently document higher BRD incidence rates than observed pre-harvest, suggesting subclinical BRD is common. Data from numerous studies document lower average daily gains (ADG) from cattle with AV lung lesions at packing plants that were not treated for BRD compared with cattle with normal lungs. Scoring lung lesions at the packing plant can be a useful tool for gaining insight into BRD incidence. Data indicate that BRD lowers ADG by 0.2 lbs on average, and lowers the USDA Quality Grade by 50 marbling points.

Keywords: bovine respiratory disease, incidence, characteristics, lung scores.

It has become cliché to note that 'Bovine Respiratory Disease (BRD) is the most expensive disease of cattle in the United States (US)'. Estimates always include the cost of sickness treatments, deaths, and loss of performance (Smith, 1998; Epperson, 1999; Irsik, 2010; Leach *et al.*, 2013). Almost all discussion and estimates of loss revolve around calves, especially stressed calves immediately post-weaning.

In calves affected with BRD during the first 4 weeks post-weaning, the relationship between their BRD clinical signs and treatment outcomes is disappointing. Although dozens of descriptors have been and continue to be used to characterize BRD clinical signs, three characteristics have become the principal targets for identifying clinical BRD. The key clinical characteristics are: scaling levels of attitudinal depression, loss of appetite as judged by rumen fill, and abnormal respiration (rate and character). Finding cattle affected with BRD during the early stages of the disease is generally considered the most critical key to successful intervention (Smith, 1998). When cattle are identified as 'sick' and are 'pulled' from their group for individual treatment, rectal temperature becomes the most common scale used to estimate the severity of their illness. The acronym formed from the first letter of the four key signs, e.g. depression, appetite, respiration, and temperature is D.A.R.T. and has gained wide acceptance as a training tool for helping caregivers learn to identify cattle during the early stages of BRD.

Regressing the rectal temperatures of 'sick' cattle against BRD relapse events and BRD deaths in over 30,000 BRD feeders indicate temperatures <104.0 °F have an $R^2 < 0.5$. Regression against 105.0 °F had an R^2 of over 0.67 (Anonymous, 1982–1985a, b). While selecting a higher rectal temperature to classify cattle as sick will improve the statistical relationship between BRD diagnosis and BRD deaths and relapses, and therefore better 'prove' the suspect animal was suffering from BRD, requiring a higher rectal temperature to classify cattle as sick will also increase the number of BRD-affected cattle not being treated. It is reasonable to consider many of these that have a rectal temperature below the veterinarian's cut-off for BRD treatment would be 'subclinical' BRD cases. Higher rectal temperature cut-offs lower the total expense of initial treatment costs. However, while treatment costs are saved, the loss of growth performance of 'subclinical' BRD not treated may offset the treatment cost savings.

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Until 3 decades ago, the magnitude of BRD subclinical lesions had not been characterized. Griffin's observations of packing plant offal from the known sets of finish fed cattle indicated BRD lesions could be very prevalent in groups of cattle that had experienced little clinical BRD during their stay in a feedyard. And conversely, in some groups of cattle BRD lesions were present at rates lower than the observed preharvest sickness rates, suggesting that not all cattle exhibiting BRD signs confirmed by high rectal temperatures are true cases of BRD. 'Don't let a thermometer do your thinking' or 'Thermometers lie' can be an interpretation of these packing plant observations. However, cattle with severe BRD adhesive lesions involving over 50% of the lung were found to have hot carcass weights 10–15% lighter than carcasses from cattle in the same group with grossly appearing normal lungs. It was not uncommon to observe a third or more of the lung adhering so tightly that it would be torn away as the pluck (heart, lungs, and trachea) was removed (Anonymous, 1982–1985a, b).

BRD was not the only cause of adhesive pulmonary events observed in the packing plant. Lung adhesions were occasionally observed in association with the inflammatory response across the diaphragm due to severe liver abscessation or severe liver fluke infestation (Anonymous, 1982–1985a, b).

BRD has been associated with other non-infectious etiologies such as 3-methylindole (Bingham *et al.*, 2000), nutritional interactions and deficiencies (Galyean *et al.*, 1999), production management tools such as hormonal implanting (Munson *et al.*, 2012), sourcing and prior or pre-weaning management (Smith, 1998; Reinhardt *et al.*, 2009; Renter *et al.*, 2013), and genetics (McAllister, 2010). A tremendous amount of work has investigated pathogen interactions related to both clinical and subclinical BRD. The most notable is the relationship between the development of BRD and exposure of normal cattle to other cattle persistently infected with Bovine Viral Diarrhea Virus (BVD-PI). The clinical BRD incidence is magnified by the presence of other cattle that are persistently infected carriers and shedders of BVDV (Loneragan *et al.*, 2005). When BRD is considered as a whole, the term complex is frequently added (BRDC), because epidemiologic studies demonstrate complex interactions between the individual bovine and its environmental history, past, and present (Taylor *et al.*, 2010; Renter *et al.*, 2013).

Griffin and Perino outlined a protocol in the early 1990s to evaluate health and growth performance differences between newly weaned feeder cattle that were randomly selected to be treated with oxytetracycline for their BRD signs or denied antibiotic therapy. At the end of the study there were no differences in the BRD relapse rate or the BRD death rate. Just over a third of the weaned calves were observed to have BRD signs prior to harvest. However, over 70% of the cattle had BRD lesions grossly observable at the packer's offal line. Only a quarter of the cattle with lesions had been treated for BRD prior to harvest (Anonymous, 1993). Similar finding were made by Wittum *et al.* (1996) in their study of weaned calves over three calving seasons from a biosecure closed herd. This group found gross lung lesions at the packing plant, the majority of which were adhesive in over 70% of cattle; however, <40% of the cattle had been observed to have BRD signs during their life. Of those observed

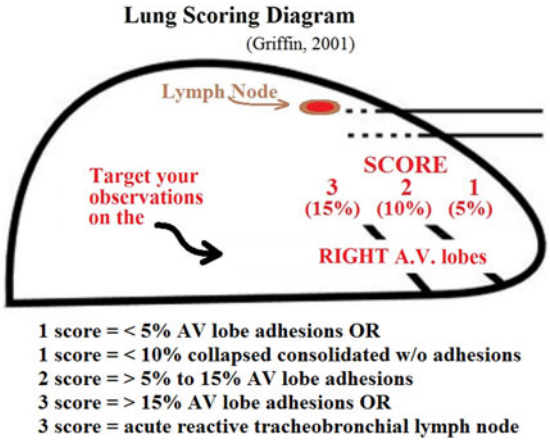

Fig. 1. Lung-scoring system used to characterize lung lesions identified at harvest of cattle at packing plants (Griffin, 2001). This system facilitates rapid and consistent scoring of lesions. 'AV' = anterior ventral.

with BRD, there was less than an 80% agreement between the BRD signs and the presence of gross lung lesions from lungs collected from the packing plant. The bottom line is that BRD is not consistently, accurately identified in cattle. Besides lung scarring associated with BRD, Wittum *et al.* (1996) documented a 6% (0.16 lbs) reduction in average daily gain (ADG) associated with the presence of a lung lesion observable at the packing plant.

Bryant (1997) was the first to develop a lung scoring system for use during post-harvest evaluation of lungs in packing plants. His work documented that as little as a tenth of the anterior ventral (AV) lung with adhesive BRD lesions was associated with a lowering of ADG (Bryant, 1997). Dr Bryant's observations suggested that there were three important classifications of grossly observable lung lesions that could be made at the packer's offal line at chain speed (one lung observation every 10 s). The classifications were: (1) collapsed consolidated lung parenchyma; (2) adhesions of the lung to itself or to the thoracic pleura; and (3) acutely reactive tracheobronchial lymph nodes. The majority of the AV lung involvement was <5% of the total lung but even this small amount of lung involvement could be associated with decreased cattle ADG. Lungs with AV lesions in <5% of the lung became his severity involvement score of '1'. The statistical variability in ADG impact rapidly increased when more than 15% of the AV lung was involved. This led to AV involvement of >15% being classified as a maximal score of '3'. AV lung involvement between 5 and 15% became a lung involvement score of '2' (Fig. 1). The significance of the involvement score was factored against the impact of the type AV lung lesion (collapsed/consolidated being the least impactful, adhesions the next most impactful and the presence of acutely reactive tracheobronchial lymph nodes the most impactful) (Bryant, 1997; Gardner *et al.*, 1999). The gross lesions commonly recognized when lungs are scored at packing plants are described in Table 1.

Since the initial observations linking AV lung lesions at packing plants to cattle that had never been observed to exhibit signs

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Table 1. Gross lesions commonly recognized when lungs are scored (as indicated in Fig. 1) during post-harvest evaluation at packing plants

LUNG SCORING CODES EXPLAINED AV right-side evaluation
0 Normal/negative (includes depressed healed areas), ½ = half views BUT evaluated AV right side
1 5% or less of lung affected with a granular, dark, purplish, and meaty: collapsed/consolidated – *Mycoplasma* like (bronchiectasis – AV bronchopneumonia), and/or **minor** adhesions/pleuritis (fibrin tags)
2 Numerous adhesions (fibrin tags) affecting more than one AV lobe (>5% lung volume) and/or small missing piece of lung … and/or … >10% affected with *Mycoplasma*-like lesions (dark depressed purple areas) including bronchiectasis – AV bronchopneumonia
3 FUBAR (Fouled Up Beyond All Recognition): **Large amount of missing lung tissue**, Caused by pleuritis and/or adhesions involving >15% of the total lung volume and/or **active** (inflamed tracheobronchial and mediastinal lymph nodes, may see acute to chronic inflammation …swollen tissue, new adhesions. Note: look for purple ink … Inspectors usually condemn these lungs … do not confuse with contamination condemnation or heart condemnation.

of BRD, there has been a continual flow of work published that documented similar findings (Thompson *et al.*, 2006; Schneider *et al.*, 2009; Leach *et al.*, 2013; Busby, 2014; Rezac *et al.*, 2014). The impact of BRD on growth has been variable but the range published by these researchers has been a decrease in ADG between 0.10 lbs day^{-1} and over 1 lbs day^{-1} . These researchers reported cattle subclinically affected with BRD as cattle that had never been observed as showing clinical signs of BRD and yet were found to have lesions in the AV lung lobes at the packing plant consistent with previous BRD. In their reports, cattle with subclinical BRD had decreased ADG during finish feeding of between 0.07 and 0.33 lbs. Additionally, some of the reports included lowering of carcass values associated with lowering of USDA Quality Grade and increased carcass trim loss. On average, the loss in Quality Grade was 50 marbling points.

Financially, what does this mean? As an example, if the price differential was $10 per CWT (100 lbs) between carcasses with a Select Quality Grade and carcasses with a Choice Quality Grade, a 900 lbs carcass from an animal affected with BRD would have on average 50 fewer marbling points, which is half the marbling required to move a carcass from 'Select' to 'Choice'. The 50 marbling point decrease across a group of cattle would translate to $45 less for cattle affected with BRD compared to the carcass value for non-BRD affected cattle. If the AV lung adhesive rate from cattle never observed with BRD signs (subclinical BRD) is 20% in a group of 100 finish-fed cattle, the loss in carcass value alone would be $900 for this group of cattle. If the average ADG decrease for cattle with AV lung lesions is 0.2 lbs and if these 100 cattle had been on feed for 180 days, there would be 720 lbs less weight to market. If the value of live cattle is $1.45/lbs, the gross dollar return would be an additional $1044. In a nut shell, in this financial example, a 20% subclinical BRD rate costs the cattle feeder $19.44 for every finish-fed animal, due to lowered weight gain and lowered carcass value.

Cattle feeding is comprised of two distinct businesses. Ownership and management of a feedyard is an 'asset' business. Ownership and management of cattle in a feedyard is an 'equity' business. That is, a cattle feeder can own cattle in a feedyard by providing sufficient equity to assure the banker from whom he or she borrows money that they will be able to repay the loan. Seldom is the risk of loss >$200 per head; therefore, a cattle feeder need not have more than $200 per head on feed. The $19.44 loss associated with subclinical BRD in the example above represents approximately a 10% loss in equity. To view it a different way, if the subclinical BRD had been prevented, the cattle feeder would have realized an additional 10% return on their equity during the 180 days the animal was being finish fed. This equals a 20% return on equity on a yearly basis. The impact of subclinical BRD is enormous.

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