

Evidence-based lameness detection and treatment in cattle

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Part 1. What is lameness?

Lameness is a condition of abnormal locomotion associated with pain. When we discuss lameness, we are talking about pain. Lameness is caused by underlying diseases, but lesions and lameness are not the same thing. In cows, although there is often a correlation between lameness and lesions (such as digital dermatitis, sole ulcers, or white line disease), there are enough exceptions that the correlation should not be assumed; the amount of time it takes to resolve a lesion may or may not correlate with the amount of time it takes to resolve the condition of lameness.

For example, Groenevelt et al. (2014) found that some cows with lesions that appeared to be severe (toe necrosis and sole ulcers) were only moderately lame. O'Callaghan et al. found that in general, more severe lesions correlated with greater derangements of locomotion, but also that some cows with lesions that appeared to be severe were not lame at all. The lack of reliable correlation between lesions and locomotion is also supported by Frankena et al. (2009), who scored cows on a 5-point scale and recorded lesions. Cows with no digital dermatitis (DD), mild DD, or severe DD, had locomotion score means of 2.3, 2.5, and 2.7, respectively - less than 0.5 point difference in mean locomotion score between no lesion and a severe lesion, on a 5-point scale. Moreover, 15% of cows with no lesions were lame, while more than 60% of the cows with severe DD lesions were not classified as lame (score $\geq 3/5$). The results of that study were similar for cows with heel horn erosion - locomotion score means for slight, moderate, and severe lesion cows were 2.3, 2.4, and 2.5 respectively, and more than 70% of cows with severe heel horn erosion were not classified as lame. Similarly, Manske et al. (2002) examined over 4,500 dairy heifers and cows in Sweden and found that 72% of them had lesions (including heel-horn erosion, sole hemorrhages, erosive dermatitis, abnormal claw shape, white-line disease, and sole ulcers), but only 5% of the cows were lame.

How do we know that lameness is due to pain? Because when pain is relieved, lameness (abnormal locomotion) is mitigated. For example, Flower et al (2008) found that a single dose of the anti-inflammatory drug ketoprofen resulted in decreased locomotion scores in dairy cows with naturally-occurring lameness when compared to untreated controls, and meloxicam treatment improved the locomotion of beef cattle with naturally-occurring lameness (Nagel et al, 2016).

Why does the distinction between lameness and lesions matter? Because we need to be clear about the problems we are endeavoring to solve. In general, we want to treat and resolve

lameness, for several reasons. First, lameness is a welfare issue because it is associated with pain. The classic indicator of lameness is visually abnormal locomotion, particularly derangements in gait symmetry; in a lame cow, the legs move at different speeds and stride length is altered in the affected limb. An additional common sign of lameness in cattle is an arched back instead of flat back posture. Lameness is associated with familiar negative effects in dairy cows, including decreased production, increased risk of culling, and diminished fertility. We treat the lesions that cause lameness in order to obtain the reduction of lameness.

Part 2. The importance of early detection

Fortunately, lameness detection is not difficult; with practice most people can learn to identify lame cows by recognizing the typical alterations in locomotion. Part of the first job I ever had at a dairy farm, many years ago, was watching the cows in a pen and identifying those that were showing behavioral signs of estrus. This practice has been replaced with automated estrus detection methods like pedometers, or with synchronization programs that eliminate the need for visual estrus detection. Thus far, no valid, easy, and affordable automated method of lameness detection has been developed. Evidence suggests that the implementation of lameness detection practices similar to the estrus detection practices of years gone by will yield benefits to cows and to farms because of the improved outcomes that come with early detection and treatment of lameness-causing conditions.

It has been established that early detection and treatment of lameness conditions has a substantial beneficial effect on treatment outcomes. This is most pronounced in the case of claw horn disruption lesions (CHDLs) such as white line disease, sole hemorrhages, and sole ulcers. A pair of research projects done in the United Kingdom by the same research group illustrates this point well. In the first study (Thomas et al, 2015), cows were locomotion scored every 2 weeks and treated as soon as an elevated score was observed, so no cow waited more than 2 weeks after diagnosis for treatment. When the treatment was a therapeutic foot trimming, application of a wooden block to elevate the paired claw, and the non-steroidal anti-inflammatory drug ketoprofen, more than 50% of cows were walking normally 35 days after treatment. By contrast, in another study cows had to have at least 2 observations of lameness (also performed every 2 weeks) prior to treatment, so no cow was treated less than 2 weeks after the development of lameness. When the same treatment was delayed by at least 2 weeks, 42 days after treatment only 16% of treated cows were walking normally, and more than a third of those cows developed lameness in the limb contralateral to the limb that was initially affected.

In addition to improving the odds of recovery, early detection and treatment of CHDLs may decrease the likelihood of recurrence. Sole ulcers typically form under the caudal aspect of the distal phalanx in dairy cows. Using computed tomography, the formation of bony exostoses from the caudal aspect of the distal phalanx has been observed in cows with a history of

treatment for CHDLs, with a greater volume of new bone formation in cows with a history of chronic lameness. (Newsome et al., 2016). Given that caudal aspect of the distal phalanx is already the area most at risk of sole ulcer formation, the addition of more bone in the area is likely to diminish the likelihood that an affected cow will ever attain and maintain soundness.

Lameness is easily detected through regular assessment of locomotion in the herd. Early detection enhances the likelihood of a good outcome and decreases the development of sequelae that are likely to lead to chronic lameness.

3. Lameness treatment

The most common causes of lameness in dairy cows are digital dermatitis (DD), which has an infectious component, and CHDLs.

Digital dermatitis is common in dairy and beef cattle, and often DD lesions are apparent in cows that are not lame. Treatment of individual cases will not resolve a herd problem with DD; control measures are also important. Digital dermatitis is particularly challenging because of low cure rates and the frequency of recurrence. In the United States, the most common treatment for DD lesions has been the topical application of tetracycline-class drugs. Topical treatment of DD lesions with tetracycline-class drugs typically results in improvement, followed by frequent recurrence of DD lesions. For example, in a study in which 43 lesions were treated with topical tetracycline and a foot wrap (bandage) and monitored for at least 50 days afterward, 40 of the lesions improved, but only 9% resolved to normal skin and 88% of the lesions got worse again within 224 days (Krull et al, 2016). The lesions that resolved to normal skin after treatment did not reoccur. An alternative to antibiotic drugs for the topical treatment of DD is salicylic acid (SA). When compared to washing only with water and treatment with tetracycline spray, salicylic acid paste was found to result in higher percentage of healed DD lesions 21 days after treatment (Kofler et al, 2016). By contrast, a comparison between chlortetracycline spray and topical salicylic acid powder with wrap placement showed no difference in outcomes at days 3 and 14 post-treatment, but at 34 days post-treatment, the SA group had a significantly higher rate of healing (13.6% vs 3.1%), and also had a higher rate of lesion shrinking (Schultz and Capion, 2013). Differences in pain behavior between the two treatments did not achieve statistical significance. With the low cure rate and high rate of recurrence, it especially important to implement preventive measures against DD, including good farm hygiene (clean and dry housing areas), pasture access, and routine foot bathing and hoof trimming (Evans et al., 2016).

NOTE: there are no FDA approved treatments for digital dermatitis. All drug treatments for the condition are therefore extra-label and applicable regulations must be followed, including the establishment of appropriate withholding times. Drug residues have been detected in the milk of cows treated topically for DD with tetracycline and salicylic acid.

The cornerstone of treatment of CHDLs is therapeutic hoof trimming. In addition, a wooden or rubber block may be placed on the paired claw to elevate the affected claw; this procedure has been found to improve locomotion in treated cows, indicating that the placement of a block on the paired claw does reduce pain (Pluss et al, 2021). Thomas et al (2015) performed one of the few randomized, controlled clinical trials of CHDLs in dairy cows, using the combination of a lesion and abnormal locomotion as the enrollment criteria, and normal locomotion 35 days after treatment as the definition of a cure. The cure rate was 24.4% for cows treated with only a trim, 28.6% for trim plus drug treatment with ketoprofen (3 days x 3 mg/kg BW), 35.9% for trim combined with block placement, and 56.1% for the combination of a trim, block placement, and treatment with ketoprofen. The improved cure rate with the trim + block + ketoprofen compared to trim only was statistically significant. Treatment with the NSAID ketoprofen has therefore been identified as providing both analgesia and improved resolution of lameness.

Simple steps can and should be taken to improve the wellbeing and condition of lame cows. When given the choice to walk on artificial grass or dirt-over-gravel, cows prefer to walk on artificial grass, and the preference is more pronounced among lame cows, suggesting that the artificial grass surface produces less pain than dirt-over-gravel as a walking surface for lame cows (Buijs et al, 2019). In a study of cows with a lameness score of 4 on a 5-point scale, all cows were treated with therapeutic hoof trimming; then, they were randomly assigned to return to freestall housing or be placed in a hospital pen with deep straw bedding. When the cows were evaluated 3 weeks later, 60% of those housed in the hospital pen had improved locomotion (less pain), while only 27% of those maintained in their usual housing had improved locomotion (Thomsen et al. 2019). When cows with a locomotion score of 3/5 had no treatment other than being put out to pasture or left in a barn, the average locomotion score of the pastured cows decreased by 1 point on a 5-point scale after 4 weeks, while the locomotion scores of the cows that remained in the barn did not change (Hernandez-Mendo et al, 2007).

4. Summary

Lameness in cattle indicates pain. Because of the risk of chronicity developing with delayed treatment, it is important to identify and treat lame cows quickly. In addition to hoof trimming and drug treatment, management procedures such as good barn hygiene and providing softer footing can reduce the prevalence of lameness in a herd.

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