Lameness Treatment and Prevention: No Pain, No Lame

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Take Home Messages

- Lameness prevalence is highly influenced by the number of chronic cows.
- The transition period is a high risk time for the development of horn lesions due to changes that occur inside the claw that facilitate movement of P3 and put pressure on the corium.
- Timely and appropriate hoof trimming with extensive modelling is a key component of a preventative strategy.
- Appropriate treatment of sole ulcers and white line lesions includes the use of blocks and strategic use of NSAIDs.

Introduction

Lameness is a painful, costly disease that affects productivity of cows through its effect on milk production, culling and reproductive performance. In addition, lameness is also a major animal welfare concern, as it is highly prevalent, and more importantly, easily recognizable by consumers. Worldwide, clinical lameness prevalence estimates range from 20 to 30%. Estimates of the prevalence of foot lesions found at hoof trimming are much greater, ranging from 40 to 70% of cows (Solano et al., 2016). Types of lameness due to foot lesions can be broadly categorized into infectious (digital dermatitis (DD) heel horn erosion, foot rot) and hoof horn (ulcers, white line disease, hemorrhage). Although infectious lesions are the most common type of lesions in most herds, hoof horn lesions are far costlier due to their effects on milk production and culling.

Economic losses due to hoof horn lesions are difficult to quantify, yet it is becoming apparent that affected cows usually hold higher production potential, with production losses starting prior to lameness diagnosis (Bicalho et al., 2008). Typical production losses for cows with hoof horn lesions range from 200-500 kg; moreover, these cows are at increased risk of culling (Cramer et al., 2009).

The focus of this paper is to describe recent advances in knowledge about lameness that dairy industry personnel can use to adapt foot health programs.

■ Lameness is a Chronic Disease

Lameness has always been thought of as a chronic disease, but it is surprising how much the current prevalence of lameness is influenced by chronic cases. Recent data from a multiyear study in the UK suggests that up to 83% of lameness cases are due to cows having at least 1 lameness case in their history. In this same study, a range of 5-25% of lameness cases were due to cows having a lameness case at least >4 months prior (Randall et al.). Our research group is observing similar trends in locomotion scoring data from over 1200 cows. This data indicates that 64% of cows lame prior to their dry-off hoof trim became lame in their next lactation. Conversely, only 30% of cows not lame prior to their dry off hoof trim became lame in their next lactation. Similarly, lesion data from the same cows would indicate that only 16% of cows develop lesions in the first 150 days of their lactation if they did not have a lesion at their dry-off trim. This number of cows with lesions is much lower when compared with lesion data that does not distinguish between new and chronic cases (Solano et al., 2016).

The exact nature of how an initial case of lameness results in these chronic long term effects is not clear. A recent study in the UK has shown that cows with a history of lameness grow additional bony structures on their 3rd phalanx (P3) (Newsome et al., 2016). Similarly, data from WI indicates that heifers that have a case of DD before calving suffer long term consequences in their first lactation (Gomez et al., 2015). Data from our research group also indicates that 1st lactation animals with DD at their dry-off trim have higher odds of hoof horn lesions in their following lactation. Taken together this suggests that an initial episode of lameness results in chronic changes to the structure of the claw. These changes then create a cycle resulting in repeated episodes.

Both the UK WI data and our data described above are based on a small number of herds, which limits our ability to make inferences about a larger number of herds. However, similar trends were seen in different herds and countries, with other studies also indicating long-term effects. Thus, to address lameness, energies should be focused on prevention and appropriate treatment strategies. These treatment strategies should focus on ensuring the long-term impacts of a cow's first case of lameness is reduced.

▪ Relationship between Lameness and the Transition Period

Hoof horn lesions such as sole ulcers, white line lesions and hemorrhages are caused in a large part by movement of P3 in the claw capsule. The downward movement of P3 causes compression of the corium resulting in the production of an inferior horn. Depending on several factors, including the duration and extent of movement by P3, different lesions can develop. The exact cause of the movement of P3 is still open for debate, but enzymes and mediators that act on ligaments and the thickness of the digital cushion are all thought to play a role (Bicalho and Oikonomou, 2013; Newsome et al., 2016). For hoof horn lesions to develop forces must act on the corium, both from the exterior and interior of the claw. This makes determining the etiology of these lesions multifactorial and difficult to sort out.

Traditionally, nutritional factors and nutritionists have received a lot of the blame for lameness problems due to sole ulcers and white line disease. Surprisingly, the evidence in the literature for a causal relationship between subclinical acidosis and lameness is very weak (Bicalho and Oikonomou, 2013). Based on our current understanding of the digital cushion, suspensory apparatus and the effect that mediators and enzymes have on the tissues and structures inside the claw, the diet the cow eats is likely less important than how she eats it. This appears to be especially important in the transition period.

Recently, it has been shown that the behavior and physical properties of cows during the transition period influence the risk of lameness in the next lactation (Proudfoot et al., 2010; Machado et al., 2011).

More specifically, body condition score (BCS) and the thickness of the digital cushion (DCT) have been identified as risk factors for lameness. Studies conducted in the UK have shown that a decrease in BCS, or a low BCS, increases the risk of lameness (Randall et al., 2015). Studies done in a single herd in New York, USA have shown that there is an association between DCT and lameness (Machado et al., 2011). Recent studies from the UK have attempted to corroborate these findings and have suggested there might be additional factors involved, including inflammatory mediators released during the transition period and the suspensory apparatus (Newsome et al., 2017). The inflammatory process leads to changes in the bony structures of P3 and causes changes in locomotion that may not respond to typical therapies (Newsome et al., 2016; Thomas et al., 2016).

Taken together, this shows that the transition period is a key risk period for the development of sole ulcers and white line lesions. Ensuring cows enter the transition period with properly trimmed feet and experience a stress free transition that minimizes involuntary standing time is likely going to make a large difference in lameness incidence, and in turn, prevalence.

▪ The Role of Hoof Trimming as a Component of a Preventative Strategy

Hoof trimming has long been advocated for as a key component of a lameness prevention program. As summarized in a recent review, there is limited research on hoof trimming and there are several knowledge gaps that exist (Stoddard and Cramer, 2017). Two major knowledge gaps include the most appropriate technique and when hoof trimming should occur.

North American hoof trimmers currently use several different hoof-trimming techniques. The functional trimming method as described by Dr. Toussaint Raven is the most common. Recently, an adaptation to this method has been suggested that involves the removal of more horn under the flexor tuberosity of P3 to reduce pressure on the corium. Our research group recently evaluated this adaptation on approximately 1200 cows in 3 herds at the time of their dry-off trim. Results from this study showed that this extensive modelling resulted in 5% less hoof horn lesions in cows that were trimmed with this method at the end of their first lactation. Trimming cows in their 2nd and greater lactations with extensive modelling did not appear to reduce the number of lesions. Since we did not know the full history of the cows enrolled in the study, it is possible that the older cows already had some of the chronic changes to P3 due to previous cases of lameness.

The timing of hoof trimming should also be considered when designing a preventative program. Unfortunately, there is no good experimental data to support a particular time during lactation. Commonly, the dry-off period and mid-lactation are recommended as the ideal times for hoof trimming. Based on the importance of the transition period, it makes sense from a biological perspective to trim cows prior to dry-off to minimize the effects previously described regarding the transition period. It is likely that the impact of additional trimmings during lactation is herd dependent. Some herds that have cows in a high wear environment and do a very good job detecting lame cows are likely able to manage without an additional trimming. Other herds that do not have the same high wear environments or that do not have the capability to detect lame cows on a continual basis would benefit from an additional 1-2 hoof trimmings during a cow's lactation.

▪ Appropriate Treatment of Hoof Horn Lesions

To minimize the impact of new cases of a hoof horn related lameness on future risk, it is necessary to ensure treatments encourage fast healing and minimize inflammation. Surprisingly little data exists in the scientific literature about hoof horn treatment techniques and the effects of healing on cow productivity. Current data suggests that using non-steroidal anti-inflammatory drugs (NSAIDs) to treat early cases of lameness is effective (Thomas et al., 2015). However, similar uses in cows that have had a more chronic case of lameness did not improve outcomes (Thomas et al., 2016). It is suspected that the use of NSAIDs in new cases improves cures by controlling inflammation and its associated changes to P3. The long-term impact of NSAID's treatment on re-occurrence rates is still unclear and needs to be evaluated.

Interestingly, the 2 studies evaluating the use of NSAID's used 2 different types of blocks. This reflects the lack of data about the use of blocks and how they affect cows. Currently we know that blocks when applied to healthy cows do not negatively affect cow behaviour or milk production. Blocks improve healing by removing the pressure from the affected hoof. This reduced pressure allows the wound to heal by reducing tension that pulls cells apart, thereby enabling horn cells to grow and close the sole defect (Shearer et al., 2015). To ensure blocks are able to have this effect on healing, 2 things are critically important: proper sizing and positioning.

Proper sizing of blocks is important, for there is potential to harm the cow by applying a block that is too short. An appropriately sized block extends beyond the weight-bearing surface of the heel. In most situations this means appropriate block length is between 5 ¼-6 inches (13-16 cm). By extending the block past the weight-bearing surface of the heel, pressure on the soft heel horn is reduced during heel strike while the cow is walking and the risk of block induced hemorrhages and ulcers is reduced. Block length becomes excessive and the risk of the block being pulled off increases when they extend past the non-weight bearing part of heel to the level of the dewclaws.

Correct position of the block involves ensuring the block is applied at a 90-degree angle to the bones in the leg. This ensures that weight bearing is appropriately reduced on the affected hoof and not transferred to the outside wall of the diseased hoof. Blocks have a tendency to shift over time towards the inside of the healthy claw. This change in position alters the wear pattern of blocks and reduces the amount of time the affected claw is non-weight bearing. To counteract this, it is recommended to apply the blocks at an angle <90 degrees (sloped up towards the inside of the hoof). Even when blocks positioned in this manner do shift over time they will still prevent weight bearing on the diseased hoof.

If we choose the right block and position it properly, we create the best conditions for quick and effective healing. After applying blocks there is a need to ensure they wear appropriately and remain on for the proper time period. Block wear is influenced by block type, bedding type and flooring surface. To allow sufficient, healing blocks should remain on for at least 4-6 weeks. If a block stays on for a shorter time period, healing will likely be incomplete and the return of weight to the affected hoof will delay healing and increase the likelihood of lesion re-occurrence. A block that remains on too long can cause damage to the initially unaffected hoof due to excessive weight bearing.

To ensure blocks remain on for the appropriate time period a follow up evaluation should be scheduled in 4-6 weeks. This follow up allows for the evaluation of the healing process and to ensure block position and size are still appropriate. Cows that are not healing properly can be retreated at the time of this re-evaluation and cows that have healed can have their blocks removed. In both scenarios the re-evaluation develops a process that reduces the chance of developing chronic lesions.

▪ Conclusion

In summary, it is becoming increasingly clear that addressing lameness requires a focus on preventing chronically lame cows. This requires an integrated approach that focuses on prevention and early, effective treatment. Prevention starts with ensuring appropriate lying time, minimizing inflammatory and metabolic incidents around the transition period, and ensuring all cows receive an appropriate hoof trimming around dry-off. If a cow does become lame, applying prompt, effective treatment is essential. The implementation of a follow up evaluation will allow the early detection of non-healing lesions. Proper treatment of new hoof horn lesions requires the application of a block and the use of NSAIDs to control the effect of inflammation associated with lesion development and healing. Implementation of these strategies will reduce lameness and the associated economic and societal costs.

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