

Hoof histopathological changes in cattle subjected to the euglycemic hyperinsulinemic clamp

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Introduction

Although hyperinsulinemia has been shown to play a central role in horse laminitis, the link between insulin and hoof diseases has not been established in cattle. The objective was to investigate the effects of prolonged hyperinsulinemia on the integrity of the hoof lamellar tissue in cattle.

Materials and Methods

Five healthy adult males (two castrated) weighting 475 ± 95 kg (mean \pm SD) were subjected to the euglycemic hyperinsulinemic clamp technique (EHC) for 72 hours. Dorsal lamellar biopsies from the hind hooves were taken before (baseline), at the end (T72h) and 11 days after (T11d) the EHC period. Lamellar samples were histologically processed, stained with periodic acid Schiff (PAS) and Masson's trichrome techniques, and morphometrically analyzed. Data were analyzed by one way ANOVA considering $P < 0.05$.

Results

After 72 h of hyperinsulinemia, there was disintegration of the keratinized axis (KA) of the epidermal

lamellae (EL), with formation of an intermediate layer apparently composed of nucleated cells in keratinization between the stratum lamellatum and the stratum medium in all animals. After 11 days, there was progression of the changes seen at the end of EHC with the elongation of the EL, which presented increased length compared with baseline and T72h time points ($P < 0.001$). Although there were no changes in the basement membrane, evidences of hoof integrity loss were seen by the disintegration of the KA in the stratum lamellatum and by the presence of abnormal nucleated and anucleated cells in the stratum medium at this interface with the abaxial extremities of the dermal lamellae.

Significance

In conclusion, the euglycemic hyperinsulinemic clamp model produced histopathological changes in the bovine hind hoof that progressed after 11 days. Such changes seem to be linked to an abnormal keratinization processes and cause hoof integrity loss. Our results indicate that hyperinsulinemia can predispose cattle to laminitis and other hoof problems.

The effects of flunixin meglumine treatment and hoof trimming on lying behavior and locomotion in dairy cows

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Introduction

Lameness is a common disorder in US dairy herds and a welfare concern. Compared to non-lame cows, lame cows spend more time lying down. Although regular

hoof trimming is often a component of lameness prevention efforts, increased lying time has been observed following hoof trimming, suggesting that it may cause discomfort in dairy cows. Preliminary work suggested that treatment with a non-steroidal anti-inflammatory

drug decreases the duration of increased lying time after hoof trimming. The objective of this study was to examine interactions between lameness, hoof trimming, and non-steroidal drug therapy. Our hypothesis was that cows treated with flunixin meglumine before and after hoof trimming would spend less time lying, have improved gait scores, and produce more milk than cows that had their hooves trimmed without concurrent drug treatment.

Materials and Methods

A total of 68 lactating Holstein cows were enrolled in this study, based on lameness or the need for hoof trimming. Cows were grouped into 9 cohorts with 7 to 10 cows per cohort. All cows had their hooves trimmed using the Dutch method. One week prior to hoof trimming, cows were fitted with an accelerometer, which remained in place for 28 days after hoof trimming to record total daily lying time, duration of lying bouts and number of lying bouts. Cows were randomly assigned to 2 treatment groups: flunixin meglumine at the label dose of 2.2mg/kg body weight ($n = 34$) or isotonic saline solution at the same volume ($n = 34$), administered by intravenous injection just prior to hoof trimming and 24 h later. Cows were video recorded while walking the days before and after hoof trimming, and 7 and 28 d following hoof trimming. Videos were viewed by a masked observer and assigned a locomotion score using a 5-point lameness scale. Milk production was recorded for 1 week prior to and 2 months following hoof trimming. Treatment effect was tested using a mixed model with repeated measures. Days in milk when enrolled, parity, and initial gait score were used as covariates for lying behavior and milk production models.

Results

In each treatment group, 10 cows had locomotion scores ≥ 3 at the time of enrollment in the study, and

24 cows had scores below 3 when enrolled. There were no differences between flunixin-treated and untreated cows over the evaluation period in milk production ($P = 0.88$), locomotion score ($P = 0.82$), daily lying time ($P = 0.61$), frequency of lying bouts ($P = 0.41$), and duration of lying bouts ($P = 0.24$). Hoof trimming did not affect locomotion scores or lying time in flunixin-treated or untreated cows.

Significance

We found no effects of drug treatment or hoof trimming on the measured outcomes. High daily variability in milk production and lying behavior may make it difficult to detect differences between treatment groups. Cows in this study were not severely lame, which may have made the effects of interventions intended to mitigate lameness more difficult to detect. It is also possible that drug treatment or hoof trimming do not have effects on gait and lying behavior that can be detected using the methods in this study; however, earlier work with fewer cows had detected increased lying time after trimming. Finally, the effects of hoof trimming are likely to depend on the hoof trimmer and the method used. Future research may focus on evaluating different drugs, using other hoof trimming methods, or measuring different outcomes. For bovine practitioners, this study provides evidence that the effects of hoof trimming may not be detectable in the short term using lying time or evaluation of the cows' gait; benefits may be more tangible when evaluated over a longer time period, using different methods, or using cows with more pronounced lameness.