

An activity alert index for the detection of health disorders during early lactation

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Introduction

Monitoring of health disorders during early lactation is a key component in the management of dairy systems. Electronic systems that allow the monitoring of cow activity are available. Our objective was to evaluate the association between changes in activity (ACT) recorded by a neck collar and disease during early lactation in dairy cows.

Materials and Methods

Three weeks before the due date, 198 parous Holstein cows at the University of Florida (UF) Dairy Unit were affixed with a neck collar containing an activity logger (Hr-Tag rumination monitoring system, SCR Engineers Ltd., Netanya, Israel), providing activity data every 2-h intervals. Occurrence of health disorders (mastitis (MAS), metritis (MET), clinical hypocalcemia (HYC), digestive disorders (DIG), lameness (LAM), and ketosis (KET)) were assessed until 60 DIM by UF veterinarians and farm staff. An alert index (AI) was developed to explore the association between ACT changes and disease, considering the day of diagnosis as d0. The index included the 24h activity on the day of diagnosis (d0) minus the average daily ACT on d -3 to -5, divided by the average daily ACT on d -3 to -5. Subsequently, multiple cutoff values for the AI were analyzed by receiver operating characteristic (ROC) curve analysis to determine alert values (AV). Similarly, an analysis was performed using the day prior to diagnosis as d0. Sensitivity, specificity, and the area under the curve (AUC) were determined for the selected AI cutoff values for each disease. An AI was also calculated for healthy cows, where d0 was considered as the same date as d0 for affected pen-mates.

Results

The average AI in healthy cows ranged from 0.015 to 0.016, while in sick cows it was -0.004, -0.057, -0.219, -0.076, -0.087 and -0.062 for MAS, MET, HYC, DIG, LAM, and KET, respectively. The AV for AI cutoff points -0.1 and -0.15 showed the highest AUC in the ROC curve analyses. When -0.1 was

considered the AV, sensitivity/specificity (%) were 34/81, 50/81, 71/81, 48/81, 44/81, and 48/81 for MAS, MET, HYC, DIG, LAM, and KET detection. The corresponding AUC values were 0.58, 0.65, 0.76, 0.64, 0.70, and 0.65. When -0.15 was considered the AV, sensitivity/ specificity (%) were 28/88, 47/88, 71/88, 33/88, 39/88, and 36/88 for MAS, MET, HYC, DIG, LAM, and KET detection, and the AUC's were 0.60, 0.68, 0.8, 0.61, 0.72, and 0.63.

When the day previous to disease diagnosis was considered d0, the average AI in healthy cows ranged from 0.014 to 0.015, while in sick cows it was -0.036, -0.076, -0.106, -0.076, -0.039, and -0.0378 for MAS, MET, HYC, DIG, LAM, and KET, respectively. Sensitivity/specificity (%) of AV using -0.1 as the cutoff were 33/82, 44/82, 43/82, 46/82, 33/83, and 41/83. Corresponding AUC values were 0.59, 0.64, 0.62, 0.65, 0.67, and 0.63 for MAS, MET, HYC, DIG, LAM, and KET, respectively. When -0.15 was considered as the AV, sensitivity/ specificity (%) were 26/90, 41/90, 29/90, 37/90, 28/90, and 30/90. AUC's were 0.59, 0.63, 0.59, 0.57, 0.68, and 0.6 for MAS, MET, HYC, DIG, LAM, and KET, respectively.

Significance

Negative changes in cow activity were observed on the day of diagnosis and 1 day prior to diagnosis for cows with post-partum disease. Using the activity on the day of diagnosis to calculate an alert index, sensitivity for disease detection ranged from 28 to 71%, and specificity ranged from 81 to 90%, depending on the disease and the cutoff value. The use of activity data from the day prior to diagnosis resulted in reduced sensitivity and a slight increase in specificity. Because post-partum disease often has severe consequences, maximizing sensitivity is likely to be of most benefit in an automated monitoring tool that flags cows for further examination. Sensitivity of the activity index was highest for the detection of milk fever and metritis, and lowest for mastitis. Overall, the activity index developed in this study had only modest potential for the identification of cows for further examination in a transition cow monitoring program.