Prediction of onset of calving from tail elevation — preliminary evaluation of a novel biosensor

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Summary

- A tail-mounted gravitational measuring monitor and accompanying software was developed to detect onset of calving.
- Testing in 30 cows showed that prolonged elevation of the tail +/- an abnormal standing pattern were observed within three hours of calving.
- This novel device (and its algorithms) and preliminary results, show the potential of predicting onset of calving using a tail-mounted biosensor.

Introduction

The timing of calving can be difficult to predict accurately. Ideally, farmers would like to be able to predict to within a few hours when a cow is going to calve in order to observe normal calvings or to intervene during abnormal calving and to care for the newborn calf. But, both the signs of impending calving and the ability of the observer to detect and interpret them are highly variable. In recent years there has been renewed interest in automated monitoring of calving. Some approaches only predict the day of calving while others attempt to predict the hour of calving. One area which shows potential promise is monitoring of tail elevations pre-calving as this has been shown by behavioural observations to uniquely change within hours of calving in cows.

Hence, the objective of this study was to pilot-test a new biosensor to predict the onset of stage two of calving in dairy cows. The study was also designed to detect any problems associated with *in vivo* testing of this pre-commercial prototype and to collect preliminary data from calvings to train the predictive algorithms.

Calving monitor

The device consisted of a tail-mounted sensor with rechargeable battery, charging dock and a base station (Figure 1). The monitor was attached to the upper side of the cow's tail approximately 6 cm below the anus using a self-adhesive bandage wrap. The accelerometer and other gravitational measuring devices within the monitor recorded data every two seconds on the time the cow was either standing or lying down, and percentage of time the tail was held at various angles from 0 to >90 degrees.

Figure 1. *Calving monitor pack consisting of tail sensors, bandage wraps and base* station

Cow study

The device was tested on 30 dairy cows (10 primiparae, 20 pluriparae). Cows were housed in a group pre-calving pen and adjoining individual calving pens, both straw-bedded. The device was attached to the cow's tail for between 4 and 0.5 days pre-calving. The actual time of calving was established by 24 hr staff supervision and CCTV.

Results

Of the 30 cows on which devices were placed, 29 calvings were monitored, (10 primiparae, 19 pluriparae); 23 unassisted, four easily assisted and two difficult. The reason for the incomplete recording was the loss of one of the tail units in the bedding. In recorded calvings, prolonged elevation of the tail ($\geq$30–45 degrees for >20 seconds and four repetitions within 60 minutes), either alone or in combination with an abnormal standing pattern (within a 30 min. period) were observed within three hours of all calvings (unassisted calvings 1.5 hours; assisted calvings three hours).

Conclusions

It is concluded that prolonged tail elevation combined with increased restlessness was indicative of imminent calving. The monitor was able to detect and record the pattern of calving behaviours and the algorithm was able to detect distinct onset of calving-specific behavioural change up to three hours before birth. Thus this prototype device shows potential to detect the onset of stage two of calving. A further study in a larger population of animals with this device is required to confirm these preliminary results.