Rumination time and reticuloruminal temperature as possible predictors of dystocia in dairy cows

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ABSTRACT

The objectives of this study were to explore changes of rumination time and reticuloruminal pH and temperature of dairy cows and heifers (means ± standard deviation; age = 5.8 ± 1.9; parity = 2.7 ± 1.4; body condition score = 3.2 ± 0.2) with eutocic (EUT, n = 10) and dystocic calving (DYS, n = 8). The recording period lasted from 3 d before calving until 7 d in milk. For the comparison of rumination time and reticuloruminal characteristics between groups, time to return to baseline (the time interval required to return to baseline from the delivery of the calf) and area under the curve (AUC; both for prepartum and postpartum periods) were calculated for each parameter. Rumination time decreased from baseline 28 h before calving both for EUT and DYS cows; after 20 h before calving, it decreased to 32.4 ± 2.3 and 13.2 ± 2.0 min/4 h between 8 and 4 h before delivery in EUT and DYS cows, respectively, and then it decreased below 10 and 5 min during the last 4 h before calving. Until 12 h after delivery, rumination time reached 42.6 ± 2.7 and 51.0 ± 3.1 min/4 h in DYS and EUT dams, respectively; however, AUC and time to return to baseline suggested lower rumination activity in DYS cows than in EUT dams for the 168-h postpartum observational period. Reticuloruminal pH decreased from baseline 56 h before calving both for EUT and DYS cows, but did not differ between groups before delivery. Reticuloruminal pH showed a decreasing tendency and clear diurnal variation after calving for both EUT and DYS cows, with slightly higher AUC values in DYS cows. In DYS cows, reticuloruminal temperature decreased from baseline 32 h before calving by 0.23 ± 0.02°C, whereas in EUT cows such a decrease was found only 20 h before delivery (0.48 ± 0.05°C). The AUC of reticuloruminal temperature calculated for the prepartum period was greater in EUT cows than in DYS cows. During the first 4 h after calving, reticuloruminal temperature decreased from 39.68 ± 0.09 to 38.96 ± 0.10°C and from 39.80 ± 0.06 to 38.81 ± 0.08°C in EUT and DYS cows, respectively, and reached baseline levels after 35.4 ± 3.4 and 37.8 ± 4.2 h after calving in EUT and DYS cows, respectively. Based on our results, continuous monitoring of changes in rumination time and reticuloruminal temperature seems to be promising in the early detection of cows with a higher risk of dystocia. Depressed rumination activity of DYS cows after calving highlights the importance of the postpartum monitoring of cows experiencing difficulties at calving. The effect of dystocia on postpartum reticuloruminal pH was not pronounced.

Key words: rumination time, reticuloruminal temperature, reticuloruminal pH, dystocia, dairy cows

INTRODUCTION

Prediction of the onset of calving has great importance in decreasing neonatal losses and reducing the risk of health problems in the early postpartum period, which are crucial for maintaining profitable production on dairy farms. Behavioral changes (Huzzey et al., 2005; Jensen, 2012), and nonbehavioral external changes (Streyl et al., 2011) associated with parturition have been extensively studied in dairy cattle; however, the accurate prediction of the onset of calving is difficult due to the high variation between individuals (Rexha and Grunert, 1993; Hofmann et al., 2006). According to the recent findings of Kovács et al. (2015), assessment of cardiac autonomic activity is useful to predict calving in cases of unassisted births; however, obstetrical assistance at calving is commonly required in cases of difficult deliveries. As dystocia increases the prevalence of stillbirths (Bicalho et al., 2007) and causes intense pain to the dam (Laven et al., 2009), monitoring individuals

predisposed to dystocia during the prepartum period is crucial in terms of both production and welfare.

Current research evaluated behavioral predictors for normal and dystocic births. Miedema et al. (2011a) showed that cows with assisted calving had abdominal contractions earlier than cows with spontaneous calving, whereas others found that dystocic cows displayed restlessness earlier, raised their tail, and lay in lateral recumbency with the head rested for longer than cows calving naturally (Barrier et al., 2012). However, due to the large interindividual variation in behavioral changes associated with calving, additional physiological markers are increasingly applied to predict calving time. Schirmann et al. (2013) reported on automatic measurement of rumination time in the peripartal period using acoustic sensors based on the analysis of vocal signs. Results support that daily rumination time decreases during the last week before parturition (Soriani et al., 2012; Büchel and Sundrum, 2014). A recent study has proven that monitoring rumination time during the first 10 d of lactation allows the early detection of cows with a higher probability of developing health disorders observed during the first month of lactation (Calamari et al., 2014). To date, a lack of information exists on the associations between dystocia and rumination time around calving.

Besides rumination time, reticuloruminal pH is increasingly studied in dairy cows in the peripartal period. A reduction of rumination activity around parturition can result in SARA. A rumen pH below the level of 5.5 is commonly used as a threshold value for SARA (Oetzel et al., 1999; Plaizier et al., 2008). Although the introduction of wireless telemetry systems allowed the continuous monitoring of reticuloruminal pH under field conditions (Mottram et al., 2008; Phillips et al., 2010), changes in reticuloruminal pH have not been studied in relation with rumination time around parturition.

Precalving drops of body temperature are the result of regulation of the obligatory and facultative thermogenesis activated by thyroid hormones and catecholamines (Silva, 2006), as well as sexual hormones, which directly regulate facultative thermogenesis (Hampl et al., 2006). An early study reported that body temperature in bovines dropped by up to 1°C before the onset of parturition (Lammoglia et al., 1997), and others confirmed that this could be used as a predictor of calving (Burfeind et al., 2011; Cooper-Prado et al., 2011). However, the measurement of vaginal and rectal temperatures needs constant manual checks and represents a greater risk for the prevalence of lesions in these regions. The automatic recording of reticuloruminal temperature does not have these limitations (Sievers et al., 2004); moreover, according to Costa et al. (2016), reticuloruminal temperature is a good predictor of the

approaching calving. To the best of our knowledge, the effect of dystocia on peripartal reticuloruminal temperature has not yet been studied.

The main objectives of our study were to explore the potential use of changes in rumination time and reticuloruminal temperature as possible predictors of dystocia and to identify differences in these parameters during the early postpartum period between cows having undergone difficult and normal calvings. Peripartal reticuloruminal pH was also studied.

MATERIALS AND METHODS

Animals, Housing, and Diet

The experiment was carried out at a large-scale dairy farm in Hungary (47°18′191″ N, 18°48′336″ E), with around 900 lactating Holstein-Friesian cows having a 38% prevalence rate of dystocia in the study year. The farm was visited for a 40-d period between October 10 and November 18, 2014 [temperature (average/minimum/maximum) = 3.5/−4.7/8.2°C].

Rumination time and reticuloruminal pH and temperature of 23 animals were monitored. All selected cows were inspected physically before the trial and 24, 48, and 168 h after calving. Animals that had suffered from acute or chronic health disorders (i.e., subclinical or clinical mastitis, lameness) before the trial were not included in the study. Cows with postpartum health disorders or injuries caused by parturition (i.e., clinical hypocalcemia, retained placenta, vulvovaginal laceration) were excluded (n = 3). Because of an unexpected early calving event, 2 animals were excluded due to the short precalving recording periods. Therefore, a total of 9 heifers and 9 multiparous cows (means ± SD; age = 5.8 ± 1.9; parity = 2.7 ± 1.4; BCS = 3.2 ± 0.2) were included in the study.

From 28 d before calving, dry cows were housed in a precalving group pen (measuring 35 × 20 m), which included 50 to 60 animals and was bedded with deep straw. Before calving, cows were fed a prepartum TMR ad libitum containing a dietary forage-to-concentrate ratio of 78:22 on a DM basis. After calving, cows were housed in postpartum pens, each including 4 animals. Cows were fed a postpartum TMR ad libitum with a 60:40 forage-to-concentrate ratio on a DM basis. Feed was provided twice daily at 0800 and 1600 h and water was available ad libitum. After calving, cows were milked twice daily at 0400 and 1400 h in a 4-stall herringbone milking parlor operated with DeLaval Control Valve bucket milking machines (DeLaval International AB, Tumba, Sweden) during the first 5 DIM. Following the first milking, dams were kept in postpartum pens including 3 to 4 animals until 3 DIM, then cows