

Validation of a prototype cow-side instrument for the measurement of blood ionized calcium concentrations in dairy cattle

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Introduction

There is currently no efficient and inexpensive method for field measurement of blood calcium concentrations. Ionized calcium (iCa) is the homeostatic form of the mineral and is thought to have greater biological relevance over that of total calcium. The objective of this study was to evaluate the linearity and precision of a prototype cow-side instrument (Horiba, Japan) for measuring blood iCa concentrations.

Materials and Methods

Blood (300 mL) was collected from the right jugular vein of a multiparous dairy cow (4 days-in-milk) into lithium heparin tubes immediately before (T0) and 5 minutes after (T5) intravenous administration of 500 mL of 23% calcium borogluconate. The iCa concentrations were determined using a blood-gas analyzer (ABL-800 FLEX, Radiometer) as a gold-standard. The T0 sample was diluted using 0.9% saline to create a sample with low iCa (reference interval = 1.10 to 1.35 $\mu\text{mol/L}$). The diluted T0 sample was then mixed with the T5 sample in different ratios (100/0, 75/25, 50/50, 25/75, 0/100) to obtain 5 levels of iCa concentrations (0.69, 1.0, 1.28,

1.58, and 1.82 $\mu\text{mol/L}$). Each mixture was then analyzed in triplicate using 3 different prototypes under 1-point (1P) and 2-point (2P) calibration with the means compared to results from the blood-gas analyzer.

Results

Cumulative sum tests for linearity from Passing and Bablok regressions showed no deviation from linearity for the combined results of all 3 prototypes under 1P vs the gold-standard ($P=0.19$) and under 2P vs the gold-standard ($P=0.19$). Instrument precision (coefficient of variation; CV) was determined by 10 repeat measurements of the diluted T0 sample, T0, and T5 samples under 1P and 2P calibrations. The CV ranged from 1.3 to 5% for the 3 prototypes.

Significance

Laboratory results indicate good accuracy and precision for a cow-side instrument at the tested iCa concentrations. The performance of the instrument under field conditions is currently under investigation.

Association of rumination time with non-esterified fatty acid, β -hydroxybutyrate, and serum calcium concentrations in transition dairy COWS

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Introduction

Monitoring of health status is crucial during the transition period of dairy cows. Rumination behavior has been suggested as a parameter for assessing cow health. The

objective of the current study was to explore the association between changes in rumination and blood concentrations of non-esterified fatty acids (NEFA), β -hydroxybutyrate (BHBA), and calcium (CA) in transition dairy cows.

Materials and Methods

Three weeks before the due date, 198 Holstein cows were affixed with neck collars containing rumination loggers (Hr-Tag rumination monitoring system, Israel) providing rumination time (RT) at 2-h intervals. Blood was collected 12 to 72 h after calving for NEFA, BHBA, and serum total calcium determination from a subset of cows ($n=136$). Cows were considered in negative energy balance (NEB) if serum NEFA concentrations were > 0.5 mmol/L, positive for subclinical ketosis (SCK) if serum BHBA concentrations were ≥ 1.4 mmol/L, and hypocalcemic (HYC) if serum CA concentrations were < 8.0 mg/dL. Mixed models for repeated measures were developed for the analysis of 2-h RT at the pre-calving (PRECLV; -7 to -1 d before calving) and post-calving (POSTCLV; 1 to 7 d after calving) periods. Regression coefficients and correlation between time relative to calving and 2-h rumination values was estimated for the PRECLV and POSTCLV periods for affected and healthy cows. In addition, the correlation between blood parameters and total daily RT was measured for the day of blood sample collection.

Results

Overall, 57.7%, 18.4%, and 47.7% of cows were diagnosed with NEB, SCK, and HYC, respectively. The repeated measures analysis indicated that NEB ($P<0.001$) and time ($P<0.001$) were associated with RT in the PRECLV period. During the POSTCLV period time ($P<0.001$) and NEB*time interaction ($P<0.001$) were significant. In both periods, cows without NEB had higher rumination activity across time. For BHBA, SCK ($P<0.001$) and time ($P<0.001$) were associated with RT in the PRECLV period. Similarly, in the POSTCLV period SCK ($P<0.001$) and time ($P<0.001$) were also associated with RT. In both periods, cows without SCK had higher rumination activity across time. For CA, HYC ($P<0.001$), time ($P<0.001$), and HYC*time interaction ($P<0.001$) were associ-

ated with RT in the PRECLV period. During the POSTCLV period only, time ($P<0.001$) and HYC*time interaction ($P=0.025$) were significant. In both periods, cows without HYC had higher rumination activity across time. During the PRECLV period, the correlation coefficient (r) for time to calving and RT were -0.23 ($P<0.001$) and -0.19 ($P<0.001$) for cows with and without NEB, respectively. During the POSTCLV period, the correlation coefficients for time after calving and RT were 0.18 ($P<0.001$) and 0.16 ($P<0.001$) for cows with and without NEB, respectively. During the PRECLV period, the correlation coefficients for time to calving and RT were the same for cows with or without SCK ($r = -0.21$; $P<0.001$). However, during the POSTCLV period, the correlation coefficients were 0.16 ($P<0.001$) and 0.17 ($P<0.001$) for cows with and without SCK, respectively. During the PRECLV period, the correlation coefficient for time to calving and RT were -0.25 ($P<0.001$) and -0.22 ($P<0.001$) for HYC and healthy cows, respectively. During the POSTCLV period, the correlation coefficients for time to calving and RT were 0.20 ($P<0.001$) and 0.15 ($P<0.001$) for HYC and healthy cows, respectively. Coefficients for the correlation between NEFA, BHBA, and CA levels and total daily RT on the day of blood sampling were -0.39 ($P<0.001$), -0.14 ($P=0.17$), and 0.51 ($P<0.001$), respectively.

Significance

Rumination time was reduced during the pre- and post-calving periods in cows with postpartum elevations in serum NEFA, BHBA, or low serum total CA concentrations compared with healthy cows. In particular, the association of reduced rumination time in the pre-calving period with worse metabolic status after calving indicates that this monitoring tool may have diagnostic potential in transition cows. Further research into the utility of rumination activity for decision-making at the individual and group level in the management of transition cow health is warranted.

Fetuin-A dynamics in transition cows' plasma

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Introduction

Around parturition and during early lactation, cows enter a state of negative energy balance (NEB) driven by the onset of lactation and a reduced dry matter intake. The major metabolic adaptation to NEB is adipose tissue lipolysis that releases nonesterified fatty acids (NEFA) into

systemic circulation. High plasma NEFA predisposes cows to metabolic and inflammatory based diseases that negatively impact animal welfare and increase economic losses to dairy producers. However, not all cows with increased plasma NEFA concentrations develop a disease, thus underscoring the need for novel lipid mobilization-related biomarkers that could improve accuracy of disease prediction. In humans,