

# The association between blood $\beta$ -hydroxybutyric acid in postparturient dairy cows and the incidence of clinical diseases, milk yield, milk components, reproduction, and culling during early lactation

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## Introduction

The objectives of this study was to a) evaluate the association between subclinical ketosis (SCK) and the subsequent incidence of various clinical diseases; b) evaluate the association between various clinical diseases and the subsequent incidence of SCK; and c) evaluate the association between SCK and milk yield (MILK), fat content (FAT), protein content (PROT), fat:protein ratio (FPR), linear somatic cell count (LSCC) at first test, conception at first breeding (CFB), and culling before 60 DIM (CULL60).

## Materials and Methods

Coccygeal vein blood samples were collected from 834 cows once between 1 to 30 DIM in 47 dairy herds located in northwestern Spain. The samples were collected by four veterinarians at regular biweekly or monthly herd visits and used the handheld device Optium Xceed™ (Abbott Laboratories, IL) to measure  $\beta$ -hydroxybutyric acid (BHBA) levels. Results were used to allocate cows into one of two cohorts: 1) cows with subclinical ketosis (blood BHBA  $\geq 1,400$  mmol/L; SCK1) and 2) cows without subclinical ketosis (blood BHBA  $< 1,400$  mmol/L; SCK0). Clinical events were recorded by farmers, milk yield and components records were obtained from the local dairy herd improvement associations, and reproductive and culling records were collected by the veterinarians. Generalized mixed logistic models were used for the analysis of dichotomous outcomes, Cox models were used for time-to-event outcomes, and generalized mixed linear models were used for continuous outcomes. Herd was included in all models as a random effect.

## Results

The mean  $\pm$  SD DIM at blood sampling was  $8 \pm 5$  days, with 89% of the cows sampled within the first

two weeks after calving. Mean  $\pm$  SD blood BHBA was  $1,081 \pm 1,023$  mmol/L, and 31% of the cows classified in the SCK1 group.

The hazard ratio (HR) of having SCK was 1.9 times higher for cows with retained placenta (HR, 1.9; 95% CI, 1.4 to 2.6;  $P < 0.01$ ). The incidence of SCK was 38.7% and 28.0% for cows with and without retained placenta, respectively.

For cows sampled before a clinical ketosis (CK) event, the risk of having CK was 2.8 times higher for SCK1 (HR, 2.8; 95% CI, 1.2 to 6.6;  $P = 0.01$ ). The incidence of CK was 10.8% and 4.2% for SCK1 and SCK0, respectively. For cows sampled after a CK event, the risk of having SCK was 1.4 times higher for cows with CK (HR, 1.4; 95% CI, 1.0 to 2.0;  $P = 0.04$ ). The incidence of SCK was 78.1% and 25.9% for cows with and without CK, respectively.

For cows sampled before a displaced abomasum (DA) event, the risk of having a DA was 5.4 times higher for SCK1 (HR, 5.4; 95% CI, 2.6 to 11.0;  $P < 0.01$ ). The incidence of DA was 6.6% and 1.2% for SCK1 and SCK0, respectively. For cows sampled after a DA event, the risk of having SCK was 1.6 times higher for cows with DA (HR, 1.6; 95% CI, 1.2 to 2.2;  $P < 0.01$ ). The incidence of SCK was 68.0% and 28.9% for cows with and without a DA, respectively.

MILK did not significantly ( $P = 0.97$ ) differ between SCK1 and SCK0. MILK was 78.8 lb (35.8 kg) and 78.5 lb (35.7 kg) for SCK1 and SCK0, respectively.

FAT was significantly ( $P = 0.01$ ) higher for SCK1, compared with that for SCK0. FAT was 4.1% and 3.8% for SCK1 and SCK0, respectively.

PROT tended ( $P = 0.08$ ) to be lower for SCK1, compared with that for SCK0. PROT was 3.1% and 3.2% for SCK1 and SCK0, respectively.

The relative risk (RR) for a FPR  $\geq 1.4$  was 1.4 times higher for SCK1 (RR, 1.4, 95% CI, 1.3 to 1.6;  $P < 0.01$ ). FPR  $\geq 1.4$  at first test was 58.4% and 41.6% for SCK1 and SCK0, respectively.

LSCC did not differ ( $P = 0.71$ ) between SCK1 and SCK0; LSCC was 2.8 for SCK1 and SCK0, respectively.

The CFB risk tended ( $P = 0.08$ ) to be lower for SCK1, compared with that for SCK0. The CFB risk was 21.7% and 29.7% for SCK1 and SCK0, respectively.

The CULL60 risk was 2.5 times higher for SCK1 (HR, 2.5; 95% CI, 1.1 to 5.0;  $P < 0.01$ ). The incidence of CULL60 was 5.9% and 2.4% for SCK1 and SCK0, respectively.

### **Significance**

The strong association between SCK and early lactation health and performance indicates that there is a significant opportunity to reduce the incidence and impact of the disease.