

Interactions of Fibroblast Growth Factor and protein metabolism during the postpartum period in lactating dairy cows and their effect on animal health

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Project Summary

The immediate postpartum period (transition period) in lactating dairy cattle is the time when cattle are most vulnerable to metabolic disorders such as ketosis and fatty liver. These disorders often predispose the animal to additional diseases and may impair reproduction. A potential marker of metabolic distress and protein imbalance is fibroblast growth factor 21 (FGF21). The goal of this project is to investigate the relationship between FGF21 and protein metabolism during the early postpartum period in dairy cows. Samples will be collected to determine if increases in FGF21 are associated with negative protein balance. This study will provide undergraduate students the opportunity to receive training and experience in several research techniques and lay the foundation for future studies during this critical time period. Data from this work will improve our understanding of the underlying physiology during the early postpartum period and contribute to improvements in animal health, diagnosis, and interventions.

Background

- FGF21 is a protein hormone produced by the liver following fasting or feed deprivation in many species (Potthoff et al. 2012)
- In multiple studies, an increase in FGF21 has been associated with the early postpartum period in lactating dairy cows, a time when cows struggle to maintain nutrient balance. Plasma FGF21 concentrations (Schoenberg et al., 2011; Wang et al., 2018) and hepatic mRNA expression (Schlegel et al, 2013) increase at parturition and remain elevated relative to the dry period through the first 14 weeks of lactation.
- While this increase in FGF21 has been associated with increased incidence of ketosis and fatty liver and increases in β -hydroxy butyrate (BHB) and non-esterified fatty acids (NEFA) (Wang et al., 2018; Caixeta, et al., 2017) the relationship between protein concentrations and FGF21 have not been examined.
- Recent studies in rodents, humans (Laeger et al, 2014) and growing pigs (Schneider et al., 2018) have shown that FGF21 was increased following protein restriction alone and was not solely dependent on energy restriction
- We hypothesized that increases in FGF21 concentrations associated with the postpartum period are associated with decreases in blood urea nitrogen concentrations.

Expected Outcomes

Goal 1: To examine the relationship between FGF21 and protein metabolism (as measured by blood urea nitrogen (BUN)) during the postpartum period in lactating dairy cows.

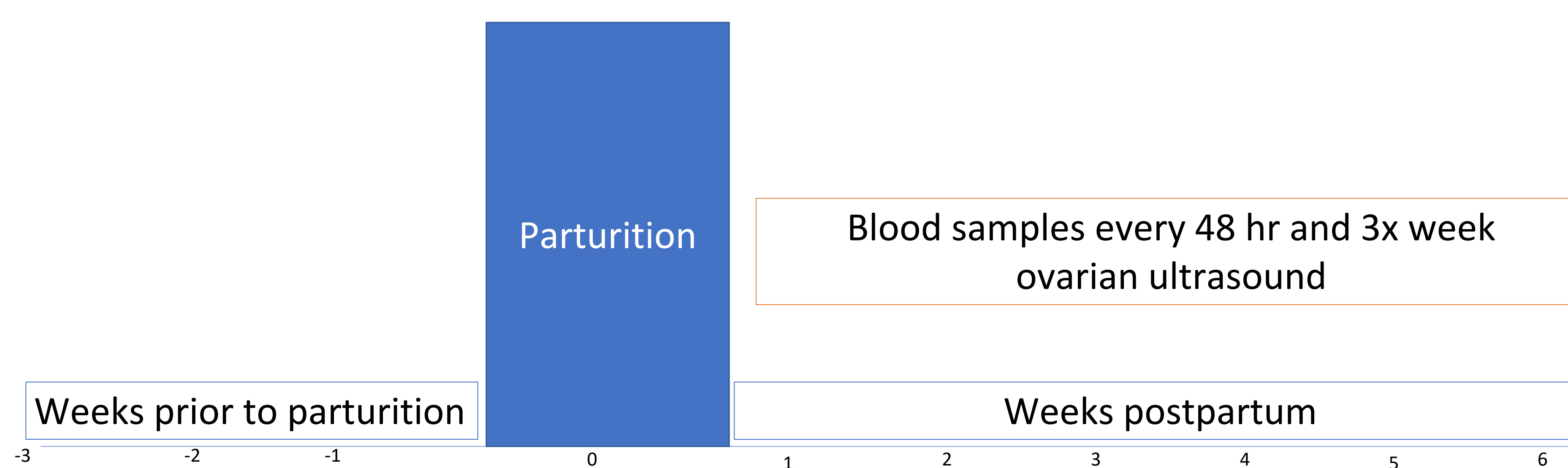
Hypothesis: Increases in FGF21 concentrations associated with the postpartum period are associated with decreases in blood urea nitrogen concentrations.

Goal 2: To examine the relationship between FGF21, BUN and reproductive health during the early postpartum period.

Hypothesis: Increased days to first ovulation will be associated with decreases in BUN and increases in FGF21.

Beyond these specific goals, samples collected from this study could be analyzed in the future for additional metabolites and support additional undergraduate research.

Experimental Protocol



Project Status

- All blood samples from cows have been collected
- BUN and BHB analyses have been completed
- Due to COVID-19, training of undergraduates for ovarian ultrasonography was not possible
- Days to first expressed estrus as determined by cow activity data will be substituted for ultrasound data
- Analysis of FGF21 is currently being completed

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