

Characterization of placentome vascular perfusion in relation to pregnancy associated glycoproteins throughout gestation in pregnant beef heifers

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Introduction

During pregnancy, blood flow to the uterus and placenta changes to support fetal demand. The placentomes serve as vascular attachment sites for exchange of gases, nutrients and fetal metabolic products. In human and veterinary medicine, non-invasive methods of ultrasonography and biomarkers have been described to assess placental health and fetal viability. Pregnancy associated glycoproteins (PAGs) are produced by the ruminant placenta and detected in maternal circulation. Current literature suggests that changes in circulating PAG concentrations may be a useful biomarker for assessing placental health. The objective of this study is to determine the association between placentome blood perfusion and circulating PAG concentrations as they relate to the health of the developing fetal calf. The hypothesis states that placentome perfusion and PAG concentration will be positively correlated and associated with neonatal outcome.

Materials and methods

A prospective, observational study was designed using 30 pregnant, nulliparous Angus heifers and variables assessed throughout gestation.

Placentome blood perfusion was visualized monthly via transrectal Doppler ultrasonography with power flow function (M-Turbo, Sonosite, Bothell, WA). Five placentomes, selected at random, were imaged per time point. Ultrasound images were analyzed using ImageJ software to determine the percent area of perfusion and integrated pixel densities. Mean blood flow was calculated from the 5 representative pixel images.

Venous blood was collected monthly via coccygeal venipuncture. PAG concentrations were determined via a commercially available serum PAG enzyme-linked immunoassay (IDEXX, Ruminant Alertys ELISA, Westbrook, ME).

Following parturition, calving characteristics including gestation length, sex and weight were assessed.

Statistical analysis was performed using commercial software (SAS v.9.1, Cary, NC). Mean blood flow and PAG concentrations were assessed via linear regression and mixed model analysis. Spearman correlation was used to compare blood flow and PAG concentration over time.

Results

Preliminary results indicate that mean placentome blood perfusion increases as gestation advances. PAG concentrations demonstrated the expected temporal trend, increasing with gestation length. PAG concentration was significantly positively linearly correlated with placentome perfusion; PAG concentration explains 77% of the variance in perfusion values. Gestation month had a significant effect on PAG concentration and placentome perfusion.

Significance

The positive linear relationship identified between circulating PAG concentration and placentome blood perfusion validates the use of transrectal power flow Doppler ultrasonography as a noninvasive technique to determine placental blood flow morphometrics. This technique will guide future studies for understanding how compromised pregnancy alters placental blood perfusion and the overall health of the feto-maternal unit.

