Determination of fetal viability

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Abstract

Assessment of the feto-placental unit is needed during maternal states of health and disease. This presentation will discuss practical approaches to assess reproductive efficiency and placental health. Biomarkers including pregnancy-associated glycoproteins, and the use of ultrasonography will be described. Current literature review will be presented describing the utilization of different markers to assess placental health during times of disease or determine fetal outcome following conception. The practitioner will be exposed to cutting-edge research in the area of placental health, yet walk away with a practical understanding where these progressive techniques can be used in practice.

Key words: fetal viability, fetal well-being, placenta

Introduction

The placenta is essential for development of the fetus and maintenance of pregnancy. Cellular communications between maternal and fetal tissues are critical to create an intrauterine environment acclimated for fetal survival. Successful pregnancy requires modulation of the maternal immune system by the placenta, among many other needs. Dysfunction of maternal-fetal communication can contribute to detrimental effects and mortality of the fetus during times of reproductive pathology.

Non-invasive assessment of the fetal-placental unit, including biomarker characterization, is a growing area of research occurring in both human and veterinary medicine for maternal states of health and disease. This presentation will discuss translating circulating biomarkers and advanced ultrasonography described in recent research to practical approaches to assess reproductive efficiency and placental health. Biomarkers including pregnancy-associated glycoproteins (PAGs), will be defined. The veterinary practitioner will be exposed to cutting-edge research in the area of placental health, yet walk away with a practical understanding where these progressive techniques can be used in practice

Feto-placental Assessment: Proteins

Measurements for circulation hormones have been described as non-invasive assessments of fetal well-being, including progesterone, estrogen sulfate, and relaxin concentrations.[10] However, due to temporal concentration changes and production by multiple locations, the use of hormones are not a sensitive assessment of the fetus.

PAGs have been evaluated for their ability to serve as a marker for embryonic/fetal viability and placental health. Circulating PAG concentrations are lower in cattle likely to undergo embryonic/fetal loss. Beef cattle that maintain a pregnancy beyond 72 d of gestation have statistically higher circulating PAG concentration at d 28 compared to cohorts that experienced embryonic/fetal loss by d 72 of gestation.[9] All cows underwent transrectal ultrasonography, which demonstrated a viable embryo at d 28 based on fetal heartbeat. Similarly, circulating PAGs were decreased in beef cattle 41 d post-insemination that had embryonic loss compared to cows that maintained their pregnancy.[8] However, ability to detect pregnancy loss or embryonic survival is assay-antibody dependent.[4] Although these studies demonstrate an association between low PAG concentrations and fetal loss, the opposite occurs with somatic cell nuclear transfer (SCNT)-derived embryos. Elevation in PAG levels is observed in recipient cows receiving SCNT-derived embryos compared with control at d 35 and 50 of gestation, followed by subsequent fetal loss.[5] This increase in circulating PAGs may reflect structural alteration of the placenta, allowing increased exposure of maternal epithelia to trophoblast products such as PAGs.[7] PAGs have been further evaluated as a marker of placental health during reproductive infections. Several studies have investigated shifting PAG concentration following *Neospora caninum* infection in cattle. Lopez-Gatius et al determined that PAG-1 concentrations decreased in aborting animals yet provided no indication of feto-placental health in chronically infected pregnant cattle that did not abort.[6] In another study, circulating PAG-2 concentrations of < 4.5 ng/mL at d 120 of gestation served as an indicator of abortion risk in chronically infected cattle.[3] Early PAG concentrations, along with seroconversion to *Neospora*, demonstrated an odds ratio of 7 for abortion by 5 to 7 months of gestation. A negative correlation with other placental products such as plasma prolactin follows a similar relationship in the face of *Neospora*-induced abortion.[3] These data demonstrate that measurement of trophoblastic products, such as PAG, can serve as a non-invasive marker of placental health, possibly indicating the occurrence of fetal mortality.

Feto-placental Assessment: Ultrasound

Rectal and vaginal examination is a simple yet non-specific method to quickly assess the developing fetus. Via rectal examination, fetal movement is easily detectable in later gestation. Upon vaginal exam, the external os of the cervix should be closed until the last weeks of gestation. Any dilation could indicate impending fetal expulsion. Ultrasonography

via the transrectal or transabdominal approaches have been described in the literature to assess fetal well-being.[2] Common subjective sonographic findings include evaluation of the fetal fluid for echogenicity and "appropriate volume" based on stage of development. Perhaps a more objective measurement of fetal well-being includes fetal heart rate. Expected fetal heart is determined gestational age.[1] Continuous or multiple measurements, allowing creation of a mean heart rate is best as fetal heart rate variability is expected during phases of movement and sleep by the conceptus. This should also be taken into account when assessing fetal movements. Overall, bradycardia is most correlated with poor fetal well-being and fetal loss.[1]

Conclusions

Several non-invasive methods, including ultrasonography, can be used to evaluate the feto-placental unity. More research is needed to clarify the practical use of circulating biomarkers for the assessment of fetal well-being.

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