NEWS AND VIEWS

Pregnancy Losses in Livestock: An Overview of the Physiology and Endocrinology Symposium for the 2020 ASAS-CSAS-WSASAS Virtual Meeting

Alan D. Ealy

Department of Animal & Poultry Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061 USA

Corresponding Author: Alan D. Ealy, 175 W. Campus Drive, 3430 Litton Reaves (0306), Virginia Tech, Blacksburg, VA 24061, Tel: 540-231-4425, email: ealy@vt.edu

ORCID number: [0000-0002-8507-6578](https://orcid.org/0000-0002-8507-6578) (A. D. Ealy).

Introduction

This year's Physiology & Endocrinology Program Committee selected a symposium focusing on *Pregnancy Losses in Livestock* for the 2020 ASAS-CSAS-WSASAS Virtual Annual Meeting. The symposium was developed to highlight the challenges faced with maintaining pregnancies in cattle and pigs. Methods are available to maximize fertilization success in livestock, but little information exists detailing ways to minimize embryonic and early fetal losses. The magnitude of pregnancy losses during the initial periods of embryo development is extensive in beef cattle and pigs, and the symposia speakers discussed the etiology of these losses, provided insights into the economic consequences of pregnancy losses, proposed developmental mechanisms that may cause these pregnancy losses, and explored how environmental stressors influence pregnancy status.

Symposium Overview

Dr. Vitor Mercadante (Virginia Tech) began the symposium by explaining the economic consequences of pregnancy loss in beef cattle. A paucity of literature is available that precisely describes the financial consequences of failed pregnancies in beef cattle, but infertility and pregnancy loss is estimated to cost producers \$3.7 billion/year. Dr. Mercadante provided insights into strategies that may reduce the magnitude of reproduction-related revenue losses in beef herds. The goal of beef cow-calf production is to wean one heavy, healthy calf with the greatest

genetic potential each year. Two ways to maximize cow-calf production efficiency are to 1) maximize pregnancy rate early in the breeding season and 2) develop and select the next generation of replacement heifers. Both of these tasks must be accomplished at the lowest possible cost. Ways to achieve these goals are to adopt reproductive technologies, and Dr. Mercadante made a convincing argument that the increased usage of timed artificial insemination programs and early pregnancy diagnosis will improve beef cow-calf reproductive efficiency.

Dr. Ky Pohler (Texas A&M Univ.) presented findings from a recent meta-analysis completed by his laboratory that provides a glimpse into the timing of pregnancy losses in beef cows (Reese et al., 2020). Nearly 48% of beef cows that are bred will undergo embryonic mortality within the first month of gestation. Figure 1 illustrates the timing and severity of these losses. There are substantial losses in the first week of gestation, with reports of losses between 25 and 30% in beef cattle. Interestingly, *Bos indicus* cattle exhibit a greater incidence of embryonic mortality than *Bos taurus* cows. This probably reflects poor environmental conditions experienced by *Bos indicus* cattle more so than genotype. Thereafter, pregnancy losses are reported at ~5% between day 8 and 16 and ~15% between day 16 and 30. Only ~5% additional losses will occur after day 30. Many of the pregnancy losses that occur in the first month of gestation are linked to maternal issues and not a result of poor-quality embryos. This is best illustrated by observing that substantial pregnancy failures still occur after transferring an apparently healthy embryo at day 7 (Ealy et al., 2019). Dr. Pohler finished his presentation by describing factors that influence pregnancy

Figure 1. Predicted pregnancy rate during gestation in beef cattle. Adapted from (Reese et al., 2020).

failure. These included estrous detection, hormone profiles, pregnancy-associated glycoprotein profiles, and sire.

Dr. Lannett Edwards (Univ. Tennessee) reported on hyperthermia impacts fertility. Exposure to elevated ambient temperatures compromises fertility, and the detrimental effects of heat stress are most severe during oocyte maturation (Edwards et al., 2005). Her research pursuits identified mechanisms that can both hinder and potentially facilitate oocyte maturation in response to heat stress. She presented convincing evidence that a mild hyperthermia may have some beneficial outcomes within the oocyte. Hyperthermia will increase the expression of kininogen, bradykinin and interleukin-6, each of which improves bovine oocyte competency. She expanded upon recent findings suggesting that estrous-associated increases in body temperature promotes critical changes at the level of cumulus-oocyte complex and ovulatory follicle, and these hyperthermia-induced changes may improve pregnancy outcomes in beef cattle (Abbott et al., 2018).

Dr. Rodney Geisert (Univ. Missouri) finished the symposium by describing how early embryonic loss is an important mechanism for maximizing litter size in the pig. There has been a 25–30% increase in litter size in pigs over the past 20 years, but pronounced early embryonic mortality still exists in today's gilts and sows. Between 20 and 50% of all viable conceptuses will be lost in early pregnancy because of space restraints within the uterus. Pig conceptuses will maximize pregnancy retention by spreading themselves throughout the placenta before attachment. Thus, the elevated incidence of early embryonic losses seems to be a “necessary evil” for gilts and sows to maximize the occupancy of their uterine space with as many conceptuses as possible. Dr. Geisert spoke about his laboratory's efforts to identify the key players in early embryo/conceptus development in the pig using CRISPR-Cas9 gene editing technologies. Highlights of this work include identifying that interleukin-1 β 2 is required for elongation and conceptus survival beyond day 12 of gestation (Whyte et al., 2018) and that conceptus-derived estrogen (CYP19A1 knock-out) is required for development beyond day 30 of gestation (Meyer et al., 2019).

Concluding Remarks

The symposia presentations provided a comprehensive outlook of our current understanding of pregnancy loss in cattle and pigs. In beef cattle, pregnancy losses occur namely during the first month of gestation in beef cattle, and these losses have noteworthy economic consequences on calf production efficiency and lifetime cow productivity. Recapturing some of the lost income will require increasing the usage of timed insemination protocols and early pregnancy diagnosis in beef herds. Environmental stressors such as heat stress undoubtedly cause pregnancy losses in cattle, but some compelling evidence was provided to indicate that mild hyperthermia during the periods of estrus and ovulation may actually improve pregnancy rates in beef cattle. Notable embryonic mortality exists in the pig, but this mortality is required to maximize reproductive efficiency.

To conclude, although no major breakthroughs have been made to reduce the incidence of pregnancy losses in cattle, substantial improvements have been made in recent years in our understanding of the mechanisms that control embryo and conceptus development in cattle and pigs, and these new insights are bringing us closer to developing tools for identifying pregnancies that may fail and for predicting animals at risk for pregnancy loss before breeding. The development of these tools will allow us to make management decisions and develop remediation strategies that ultimately will improve reproductive efficiency in beef cattle and pigs.

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