Regulation of initiation of follicle growth and dynamics of early follicular development in the sheep

Danielle Monniaux, Véronique Cadoret, Frederique Clement, Stéphane Fabre, Yann Locatelli, Philippe Monget, Rozenn Dalbies-Tran

cells, neovascularization and a new commitment of the residual follicle cells to manufacture large quantities of progesterone by the induction of genes involved in de novo steroidogenesis.

Key Words: pigfollicleovary

124 Factors influencing follicle development in gilts and sows and management strategies used to regulate growth for control of estrus and ovulation. R. Knox, *University of Illinois, Urbana, IL, United States*

Factors that affect follicle health and growth can influence estrus, ovulation, conception and litter size. Breeding herd schedules are determined by synchronized follicle growth following litter weaning in sows. Insemination over only 3 days facilitates farrowing over fewer days and helps improve the uniformity of pigs at weaning. Breeding synchrony is frequently reduced from disturbances in the follicle phase that result in delayed estrus. The failure of >15 follicles to uniformly progress beyond the 6.0 mm size within 6 days during the follicular phase is associated with failures in breeding, gestation and farrowing. In sows, the follicle phase is initiated at weaning by removal of the suckling inhibition, while in cycling gilts, luteolysis and clearance of progesterone begins the process. The timing and patterns of FSH and LH stimulation to the ovary determine follicle health and selection for ovulation. Interestingly, abnormal wean to estrus intervals in sows and deviations from a 19–22 day estrous cycle in gilts, are associated with reduced fertility. However, in both cases, it is not entirely clear whether the abnormal intervals are a direct result of problems occurring prior to or only during the follicular phase. Although the mechanisms are not entirely, factors such as boar exposure, transportation, mixing, and increased dietary energy, have been shown to induce follicle development in pigs. In contrast, inhibitors to follicle growth have been associated with heat stress, photoperiod, negative energy balance, poor body condition, parity, nursing problems, and short lactation length. Hormonal aids for reproductive management have been approved to control the follicle phase in pigs. These hormones include orally administered progestagen to delay and exogenous gonadotropins to induce the follicle phase and estrus. GnRH agonists are also being used in protocols designed to advance and synchronize ovulation for application of a single timed insemination for weaned sows.

Key Words: Pig, follicles, fertility, estrus, ovulation, sows, gilts, hormones

125 Anti-Müllerian Hormone (AMH): a biomarker for the ovarian reserve, ovarian function and fertility in dairy cows. J. Ireland[1], F. Mossa[2], [1]*Michigan State University, East Lansing, MI, United States,* [2]*Department of Veterinary Medicine, Sassari, Italy*

This presentation summarizes studies we conducted to test the hypothesis that size of the ovarian reserve (number of healthy follicles and oocytes in ovaries) positively impacts ovarian function and fertility in cattle. Key results primarily in dairy cattle show:

1) Antral follicle count (AFC) during follicular waves is highly variable between individuals but very highly repeatable within individuals.

2) Cycling heifers with low (≤ 15 follicles ≥3 mm, ~20% of a herd) vs a high (≥25 AFC, ~20% of a herd) have: i) a smaller ovarian reserve; ii) higher FSH but lower AMH, androstenedione, estradiol and progesterone concentrations and a thinner endometrium; iii) decreased response of granulosal, thecal or luteal cells to FSH or LH; and iv) a poorer response to superovulation.

3) Cows with a very high AFC as heifers have reduced fertility, fewer lactations and shorter herd longevity.

4) Cows with a low vs intermediate AFC have reduced fertility, fewer lactations and shorter herd longevity.

5) AMH concentrations are static within individuals but highly positively correlated with AFC.

6) A single AMH measurement is highly positive correlated with the average of multiple AMH measurements on different days of the cycle and AFC.

7) Fertility is not correlated with circulating AMH concentration in heifers.

8) Dairy cows with low vs a higher AMH as heifers have reduced fertility and a shorter herd longevity.

9) AMH concentrations in dairy heifers is a moderately heritable trait (36%), and negatively impacted by inadequate maternal nutrition during early pregnancy or high maternal somatic cell count.

We conclude that genetic or environmental manipulations of AMH could enhance size of the ovarian reserve and ovarian function, thereby improving fertility, response to superovulation and longevity in dairy cows.

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Key Words: ovarian reserve, anti-Müllerian hormone, dairy cows

126 Regulation of initiation of follicle growth and dynamics of early follicular development in the sheep. D. Monniaux[1], V. Cadoret[2], F. Clément[3],

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Primordial follicles embedded in the ovarian cortex are the source of developing follicles. Follicle growth activation and development up to the small antral follicle stage are controlled by cell interactions. The sheep ovary offers an appropriate non-rodent model to study these interactions, thanks to the development of in vitro and in vivo experimental approaches, ex vivo molecular analyses and in silico mathematical modeling. Each primordial follicle, composed of an oocyte surrounded by a single layer of quiescent granulosa cells, relies on nutrients and growth factors supplied by the surrounding stroma of connective tissue. In vitro cultures of ovarian cortex have shown that primordial follicles are activated by the lifting of mechanisms maintaining quiescence, some of them involving AMH secreted by already growing follicles. Afterwards, follicle development is supported by a finely tuned molecular dialog between the growing oocyte and proliferating granulosa cells. The isolation of preantral follicles and their development in vitro as individual follicles perturb this dialog, leading to an acceleration of follicular maturation. In vivo, mutations in the oocyte factors BMP15, GDF9 or their receptor BMPR1B also impair this dialog, leading to an imbalance between oocyte growth and cell proliferation, which can be reproduced by models for cell dynamics. During the growth of preantral follicles, the recruitment and differentiation of theca cells from the ovarian stroma provide them with a structural and vascularized support. In vivo exposure of sheep fetal ovaries to testosterone imprints the stroma cells so that the expression of genes involved in extracellular matrix organization and cell-cell adhesion is affected in theca at adulthood; this leads to a lower ovarian tissue rigidity that can account for the accelerated follicle growth observed in androgenized ewes. A better knowledge of cell interactions during early follicular development will help to improve the biotechnology methods of fertility preservation.

Key Words: Ovary, Follicle, Oocyte

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127 Comparison of long-term progestin-based protocols to synchronize estrus prior to fixed-time artificial insemination or natural service in Bos indicus-influenced beef heifers. J. Locke[1], J. Thomas[1], E. Knickmeyer[1], M. Ellersieck[1], J. Yelich[2], S. Poock[1], M. Smith[1], D. Patterson[1], *[1]University of Missouri, Columbia, MO, United States, [2]University of Florida, Gainesville, FL, United States*

An experiment was designed to evaluate reproductive performance of Bos indicus-influenced beef heifers (n=1,456). Weights and reproductive tract scores (RTS; Scale 1–5) were obtained prior to assignment of one of five treatments: Non-synchronized+natural service (NS); melengestrol acetate+NS (MGA+NS; 0.5 mg·animal2α (PG; 25 mg, IM) 16 or 19d following CIDR or MGA removal. Fixed-time AI was performed 66 and 72h after PG for CIDR-PG and MGA-PG treatments, respectively. Gonadotropin-releasing hormone (GnRH; 100µg, i.m.) was administered at FTAI. Heifers in FTAI treatments were exposed to fertile bulls 12d after FTAI. Blood samples were collected and ovarian ultrasounds performed at PG administration and FTAI to compare serum concentrations of estradiol and progesterone and evaluate follicular dynamics among a subset of FTAI-assigned heifers. Pregnancy status was determined after the 65-d breeding period. Mean estradiol concentrations at AI differed between MGA- versus CIDR-treated heifers (P=0.04; 8.2 versus 6.6 pg/ml). Estrous response (52% versus 53%) and FTAI pregnancy rates (40%) did not differ between MGA- and CIDR-PG treatments, respectively. Pregnancy rates were compared at 21 and 60d of the breeding period based on pubertal status (prepubertal: RTS=1–2; peripubertal: RTS=3; pubertal: RTS=4–5). Pregnancy rates differed based on pubertal status (P≤0.02) and weight (P≤0.05). No differences presented with regard to progestin source, although higher pregnancy rates (P≤0.004) were observed among NS treatments than among FTAI followed by NS exposure at 60d. These data emphasize the importance of early attainment of puberty in Bos indicus-influenced beef heifers and provide a rationale regarding the need for improvements in reproductive management of this biological type.

Key Words: Estrus synchronization, Bos indicus, beef heifer

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128 Evaluation of SexedULTRA sex-sorted semen in timed artificial insemination programs for mature beef cows. J. Thomas[1], J. Locke[1], R. Bonacker[1], E. Knickmeyer[1], D. Wilson[2], R. Vishwanath[3], A. Arnett[3], M. Smith[1], D. Patterson[1], *[1]University of Missouri, Columbia, MO, United States, [2]Wilson*