Determinants of embryo development and quality in beef cattle: Effect of pre-ovulatory follicle size, CL volume, and serum concentrations of progesterone

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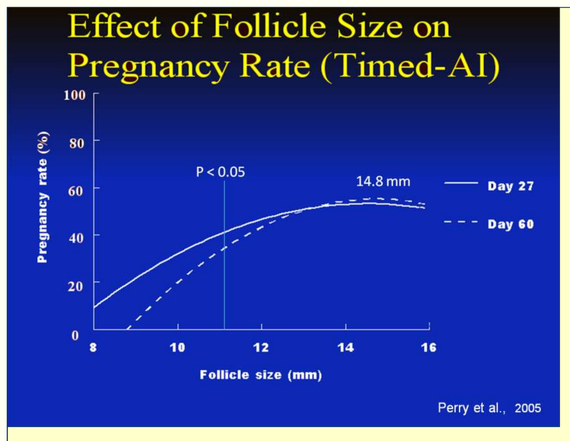
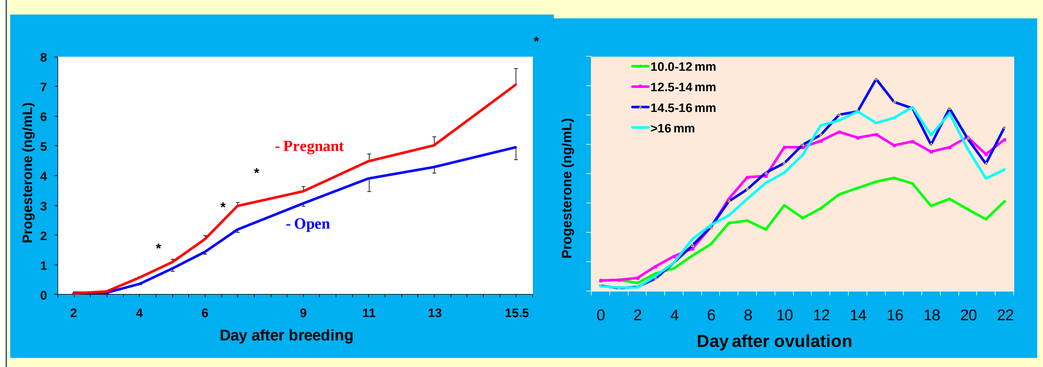
Hypothesis: Cows ovulating a small pre-ovulatory follicle will have delayed embryo development and decreased embryo quality



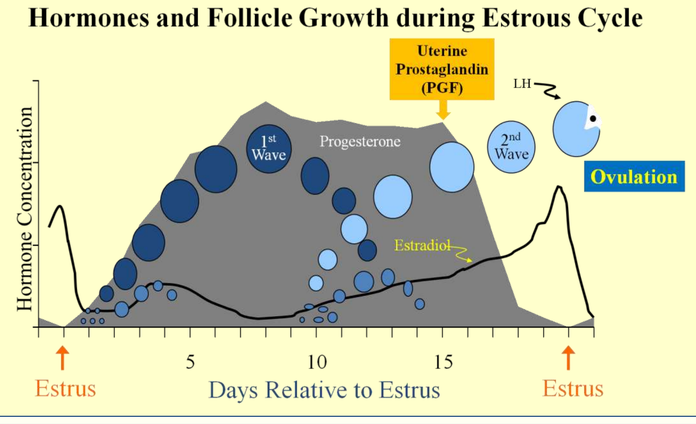
- **Cows and heifers that ovulate small follicles have reduced fertility.**
- **Approximately 30% of cows ovulate small follicles.**

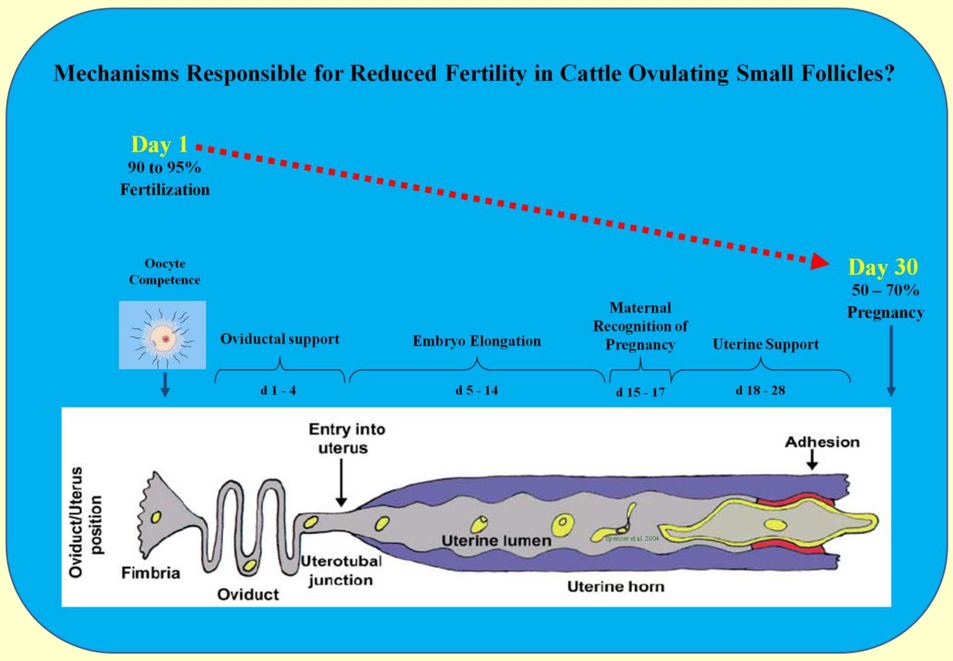


- **Cows that become pregnant produce more progesterone than cows that do not become pregnant.**
- **Progesterone prepares the cow's uterus to support a pregnancy.**
- **Ovaries of cows that ovulate small follicles produce less progesterone following ovulation than cows that ovulate large follicles.**

The current study is part of a 3 year trial where reciprocal embryo transfers following single ovulations are used to try to separate oocyte effects from uterine environment contributions to establishment and maintenance of pregnancy. Our hypothesis is that embryos recovered from donor cows that ovulated a large follicle will be more developed and (or) better quality than embryos recovered from donor cows that ovulated a small follicle. Our first objective was to correlate follicle diameter on the day of ovulation (day 0) with the size of the corpus luteum (CL) and serum concentrations of progesterone on the day of embryo transfer (day 7). Our second objective was to study the effect of follicle size (day 0), CL volume (day 7) , and serum concentrations of progesterone (day 7) on embryo developmental stage and quality.

Hormones and Follicle Growth during Estrous Cycle





Materials and Methods

Lactating multiparous beef cows (n=931; 644 donor and 287 recipient cows) were synchronized for single ovulation embryo transfer on day 7 (Figure 1). Diameter of the ovulatory follicle (day 0) and corpus luteum (CL) volume were determined using transrectal ultrasonography. Embryos recovered from donor cows were assessed for stage of embryo development and quality (Table 1 and Figure 2). The effects of follicle size (day 0), progesterone (day 7), and CL volume (day 7) on embryo stage and quality were analyzed.

Figure 1: Outline of experimental design.

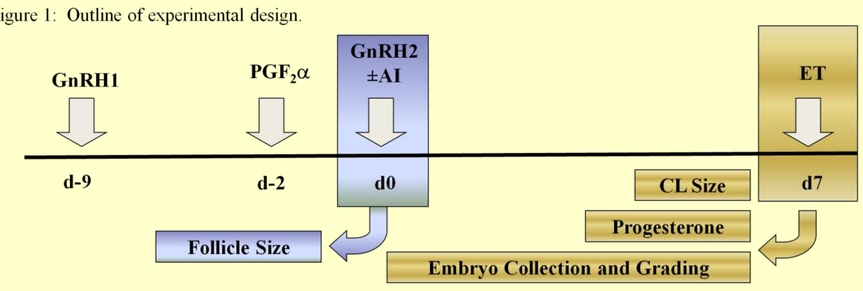


Table 1. Embryo grades for developmental stage and quality.

Grade	Embryo Stage	Embryo Quality
1	Unfertilized oocyte	Excellent or good
2	2 to 12 cell embryo	Fair
3	Early morula	Poor
4	Morula	Dead or degenerate
5	Early Blastocyst	
6	Blastocyst	
7	Expanded Blastocyst	

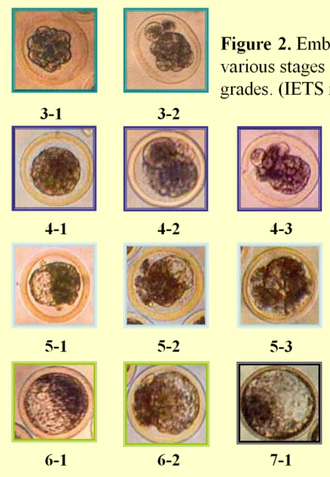


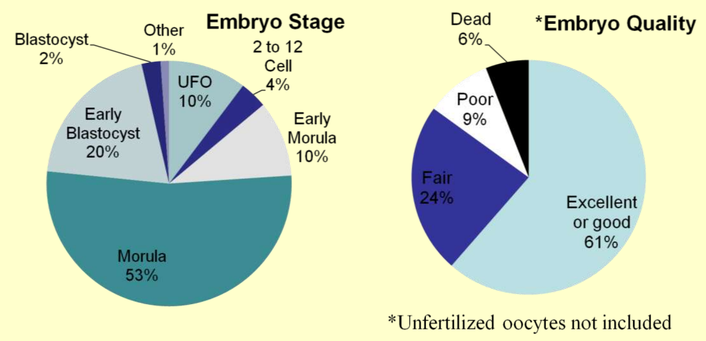
Figure 2. Embryos at various stages and grades. (IETS manual)

Results

Table 2. Number of single ovulation embryo transfers planned (Goal) and completed to date within each category.

Donor		Recipient Small	Recipient Large	Total
Small	Goal	80	120	
	Completed	39	99	
Large	Goal	120	40	
	Completed	117	39	
Total	Goal			360
	Completed			294

Figure 3. Percentage of various stages and qualities of embryos recovered.



*Unfertilized oocytes not included

- **Follicle Size ↑ → Embryo Development ↓ (P < 0.01)**
- **Follicle Size ↑ → Embryo Quality ↑ (P < 0.05)**
- **90% of eggs recovered were fertilized embryos.**
- **6% of recovered embryos were dead.**

Conclusions:

1. Ovulatory follicle size was positively correlated with d7 CL volume and [P4].
2. When all embryos were analyzed, neither follicle size, CL volume, nor [P4] affected embryo development but an increase in follicle size tended to improve embryo quality.
3. When only live embryos were analyzed, embryos were more developed as follicle size decreased and CL volume increased. Additionally, embryo quality improved as follicle size increased.

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