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OVARIAN FOLLICULAR WAVES AND SECRETION OF FOLLICLE-STIMULATING HORMONE AFTER ADMINISTRATION OF GnRH AT ESTRUS

J. R. Pursley and J. S. Stevenson

Summary

An experiment was conducted to examine the effects of GnRH on the secretion of FSH, LH, estradiol, and progesterone in serum and changes in ovarian structures. Dairy cows were assigned randomly to receive either 100 µg of GnRH or saline 12 hr after estrus (day 0) was detected. Blood was collected daily to assess changes in serum estradiol and progesterone and every 12 min for 8 hr on days 8 and 15 after estrus to assess concentrations of FSH and LH. Diameter and number of follicles were determined daily by real-time ultrasonography. Two patterns of follicular development were observed. The day of peak diameter of each dominant follicle (three or four per cycle) was synchronous with increases in estradiol in serum. The dominant follicle grew at a faster rate in all GnRH-treated cows. We concluded that administering GnRH at estrus increased the pulse frequency of FSH on days 8 and 15 of the cycle, altered follicular dynamics of dominant follicles of the subsequent estrous cycle, and tended to increase concentrations of progesterone in serum of cows.

(Key Words: GnRH, Ovarian Follicles, FSH, Estradiol, Progesterone.)

Procedures

Nine mid- to late-lactation dairy cows were used in a crossover experiment in which 13 estrous cycles were studied. These cows had failed to conceive to earlier inseminations and were classified as repeat-breeders. During the first part of the study, one-half of the cows received 100 µg of GnRH (Cystorelin, Sanofi Animal Health, Inc., Overland Park, KS), and the remainder received saline at 12 hr after

estrus was detected. The cows were monitored during one estrous cycle, with a second intervening estrous cycle serving as a rest cycle. At the estrus before the third estrous cycle, the cows received the alternate treatment at 12 hr after estrus was detected and were studied as in the first cycle. During the first and third estrous cycles, blood was collected daily to assess concentrations of progesterone and estradiol-17β, and both ovaries were scanned by ultrasonography to measure and record the number and diameter of all ovarian follicles. In addition, cows were fitted with jugular catheters, in order to collect blood samples on days 8 and 15 of the cycle (every 12 min for 8 hr) to monitor characteristics of gonadotropin (LH and FSH) secretion. These days were selected because they correspond to days of the estrous cycle when the last two dominant follicles begin to enlarge in diameter.

Results and Discussion

Two patterns of follicular growth were observed. During six of the cycles, three dominant follicles emerged, whereas in the remaining seven cycles, four dominant follicles were detected. Figure 1 illustrates the increasing diameters of three dominant follicles in one cow on days 1, 11, and 15 of the cycle, along with corresponding increases in serum concentration of estradiol produced by those large follicles. The last follicle (labelled DOF in Figure 1) was the one that ovulated after the subsequent estrus.

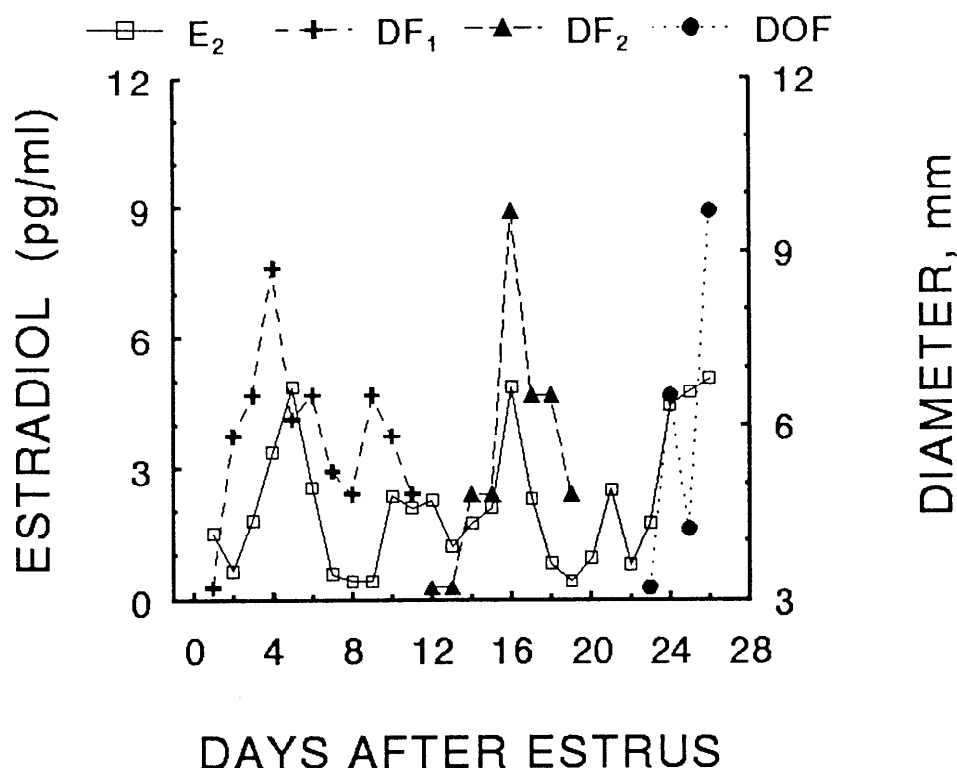


Figure 1. Concentrations of estradiol-17 β in serum and diameter of two dominant follicles (DF₁ and DF₂) and the dominant ovulatory follicle (DOF) during the estrous cycle of one cow.

As shown in Figure 1, the day each dominant follicle reached its peak in diameter, concentrations of estradiol in serum were at their highest level in the blood serum, indicating that the dominant follicles were estrogenic. The dominant follicle that eventually ovulated grew at a faster rate in all cows treated at the previous estrus with 100 μ g of GnRH.

The percentage of cows with pulses of FSH were greater ($P < .05$) on days 8 and 15 of the estrous cycle in GnRH-treated cows (Table 1). Although concentrations of FSH in serum were unaffected by treatment with GnRH at estrus, cows having three follicular waves tended to have lower FSH than those having four follicular waves (measured on

days 8 and 15; Table 2). However, cows with three waves averaged up to sixfold more pulses of FSH on days 8 and 15. There were no differences in LH secretion among treatment groups or among cows with three or four follicular waves.

Concentrations of progesterone in serum of cows having three follicular waves, but not four waves, tended to be higher after treatment with GnRH. We concluded that administration of GnRH at estrus altered follicular dynamics of dominant follicles during the subsequent estrous cycle and tended to alter secretion of progesterone as we observed in our earlier studies (1991 Dairy Day, Report of Progress 640, pp 36-39).

Table 1. Percentage of Cows with Pulses of FSH on d 8 and 15 of the Estrous Cycle after Treatment with 100 µg GnRH or Saline at Estrus (d 0)

Item	Treatment		Wave %
	GnRH	Saline	
Number of follicular waves ^b			
Three	100.0 ^c (n = 4)	33.3 (n = 3)	66.7 ^e
Four	66.6 ^c (n = 3)	0 (n = 3)	33.3
Treatment %	83.3 ^d (n = 7)	16.7 (n = 6)	

^aResponse was identical on d 8 and 15 of the estrous cycle.

^bSynchronous development of a group of follicles greater than or equal to 3 mm in diameter, which includes a dominant follicle and several subordinate follicles.

^cDifferent (P < .05) from saline.

^dDifferent (P = .01) from saline.

^eDifferent (P < .10) from corresponding four-wave cows.

Table 2. Concentrations and Number of Pulses of FSH in Serum on d 8 and 15 of the Estrous Cycle^a in 13 Cows with either Three or Four Follicular Waves after Treatment with 100 µg of GnRH or Saline at Estrus (d 0)

Item	Treatment ^a		Wave means
	GnRH	Saline	
Concentrations of FSH, ng/ml			
Three follicular waves	.9 ± .1	.9 ± .1	.9 ^d ± .1
Four follicular waves	1.2 ± .1	1.1 ± .1	1.1 ± .1
Treatment means	1.0 ± .1	1.0 ± .1	
No. of pulses of FSH			
Three follicular waves	2.1 ± .7	1.8 ± .8	2.0 ^c ± .5
Four follicular waves	.5 ± .8	0 ± .8	.3 ± .6
Treatment means	1.3 ± .5	.9 ± .5	

^aMeans represent the average response across d 8 and 15 of the estrous cycle.

^bSynchronous development of a group of follicles greater than or equal to 3 mm in diameter, which includes a dominant follicle and several subordinate follicles.

^cDifferent (P < .01) from corresponding four-wave cows.

^dDifferent (P = .07) from corresponding four-wave cows.

^eDifferent (P < .001) from corresponding four-wave cows.

^fDifferent (P = .05) from corresponding four-wave cows.