Changes in Ovarian Follicular Growth During Early Lactation in Holstein Cows

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Story in Brief

This study evaluated the effect of time after calving on size and numbers of ovarian follicles. Mature Holstein cows (n=19) were milked twice daily and rectal ultrasonography was conducted once a week. Size of the three largest follicles increased between wk 5 and 7 of lactation, whereas numbers of small, medium and large follicles did not change between wk 3 and 12. We conclude that the predominant change in follicular growth during early lactation involves increased size of large follicles and not numbers of various sized follicles. Increased understanding of follicular growth will help lead to development of better synchronization systems for artificial insemination to maximize reproductive efficiency.

Key Words: Follicles, Ovary, Dairy Cows, Lactation

Introduction

Many high producing dairy cows are unable to consume enough feed to meet energy demands during early lactation. Therefore, they rely on their ability to mobilize body energy reserves to meet energy requirements, and subsequently enter a state of energy balance deficiency. Energy balance is quantified using measures of milk production, dietary intake, and body weight (Spicer et al., 1990). Lactating dairy cows in positive energy balance have greater reproductive function than cows in negative energy balance (Spicer et al., 1990). Factors associated with improved energy balance include increased plasma insulin-like growth factor-I (IGF-I; Spicer et al., 1990) and insulin (Francisco et al., 2002) both of which stimulate growth and steroid hormone synthesis of bovine ovarian cells in vitro (Spicer and Echternkamp, 1995). However, little work has been conducted to evaluate normal changes in ovarian follicle growth during early lactation. The objective of this study was to determine the changes in follicle size and numbers during early lactation in Holstein cows.

Materials and Methods

Mature Holstein cows (n=19) in their second or more lactation were maintained at the Oklahoma State University Dairy Cattle Center and fed a total mixed ration consisting of concentrates (29%), sorghum silage (24%), alfalfa hay (16%) and cottonseed (6%). Energy concentration of the diet was formulated to support daily milk production of 100 lb. Daily feed intake was recorded and the diet was sampled weekly and composited by month for analyses.
Cows were milked twice daily (0300 and 1500 h) and milk yield was recorded. Blood samples were collected twice weekly for measurement of plasma progesterone concentrations. The ovaries of the cows were scanned weekly by transrectal ultrasonography using a linear array ultrasound scanner equipped with 7.5 MHz rectal probe (Corometrics Medical Systems, Inc., Wallingford, CT) starting at 3 wk and continuing through 12 wk postpartum to measure size and numbers of follicles. Follicles on the ovaries were measured and categorized as the largest follicle (F1), the second largest (F2) and the third largest follicle (F3) during 3 to 12 wk

postpartum. Furthermore, follicles were categorized as small (3 to 5.9 mm), medium (6 to 9.9 mm) and large (≥ 10 mm).

Experimental data are presented as least squares means ± standard errors. Data were analyzed as a repeated measures design using the MIXED procedure of SAS. Details of the statistical model were described previously (Francisco et al., 2002).

Results

Based on the first and second rise in plasma progesterone concentrations above 1.0 ng/ml, the first and second postpartum ovulation occurred on d 30 and 58 ± 7 of lactation, respectively.

Average diameter of F1 ($P<0.15$), F2 ($P<0.20$) and F3 ($P<0.08$) follicles tended to increase with week postpartum (Figure 1). Diameters of F1, F2, and F3 follicles on wk 3, 4, and 5 were less ($P<0.10$) than on wk 7, 8, 9, 10, and 11 postpartum (Figure 1).

The numbers of small, medium and large follicles were not influenced by week postpartum ($P>0.50$). Between wk 3 and 12 of lactation, numbers of small, medium, and large follicles averaged 7.9 ± 0.9, 1.5 ± 0.2, and 0.9 ± 0.2.

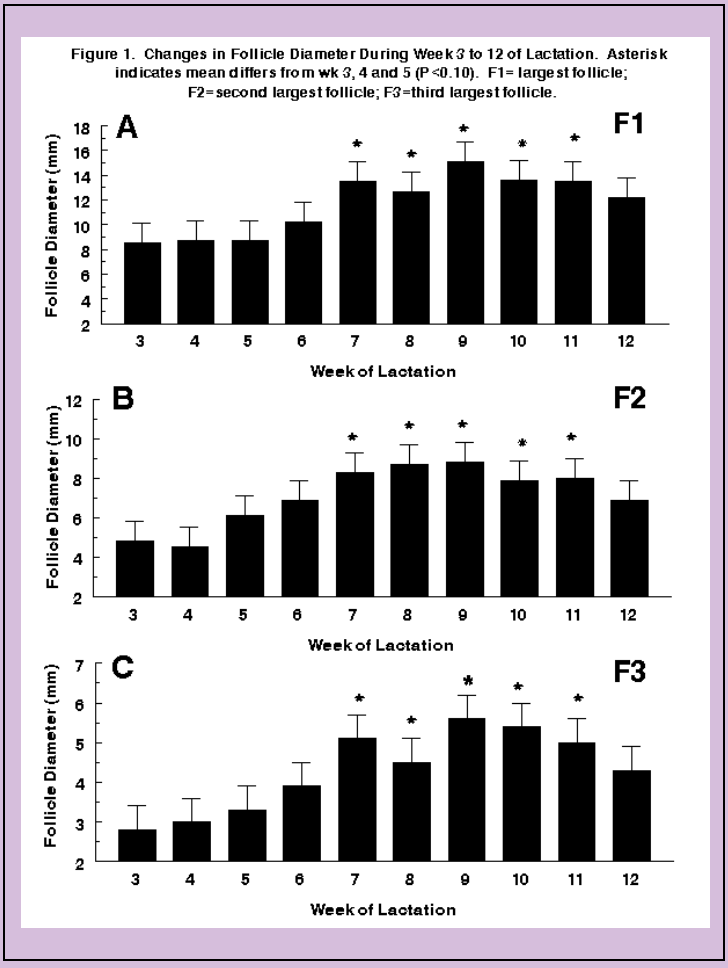

Figure 1. Changes in Follicle Diameter During Week 3 to 12 of Lactation. Asterisk indicates mean differs from wk 3, 4 and 5 ($P<0.10$). F1= largest follicle; F2= second largest follicle; F3=third largest follicle.

Discussion

Diameter of the three largest follicles tended to increase between wk 5 and 7 of lactation such that all three follicles were larger on wk 7 to 11 than on wk 3 to 5 of lactation. This period during early lactation is the same interval when insulin and IGF-I increase (Spicer et al., 1990; 2002). Number of follicles did not vary between wk 3 and 12 postpartum in the present study. This finding differs from that of Lucy et al. (1991a) who found that number of small follicles (< 5 mm) decreased while number of large follicles (> 10 mm) increased with increasing days postpartum, and energy balance was related to changes in follicular populations. Also, cows supplemented with lipids in an attempt to improve energy balance have follicles with larger diameters (Lucy et al., 1991b). The discrepancy may be explained by the difference in time frame of follicle measurement between studies. Lucy et al. (1991a) measured follicles for only a period of 7 to 25 d between 0 to 25 d postpartum whereas in this study follicle diameters were measured weekly between 3 and 12 wk postpartum. Also, because follicular populations change with energy balance, the difference in the magnitude of energy balance between groups of cows among studies may have contributed to the discrepancy in the results. Further research will be needed to determine the specific cause of increased size of the three largest follicles after wk 5 of lactation. By understanding the cause(s) and factors that regulate follicular growth, better synchronization systems for artificial insemination may be developed to help maximize reproductive efficiency.

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Acknowledgements

The authors thank Agtech Products Inc. (Waukesha, WI) for financial support of this study.

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