

OVARIAN ACTIVITY IN ULTRASOUND IMAGE AND MILK PROGESTERONE CONCENTRATION IN POSTPARTUM DAIRY COWS

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Abstract

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Eighteen pluriparous dairy cows were ultrasonographically observed twice a week from day 9–10 post partum to the 2nd ovulation. Milk samples were taken three times a week and progesterone was assayed by RIA. Before the 1st postpartum ovulation and during the 1st sexual cycle, 1.09 ± 1.09 and 1.8 ± 1.11 , respectively, subordinate follicles and 1.5 ± 0.52 and 2.4 ± 0.72 , respectively, follicular waves were found. The 1st ovulation occurred 17.9 ± 5.04 days after parturition, the length of the 1st sexual cycle was 19.4 ± 4.66 days and clinical involution of the uterus was completed 22.6 ± 4.34 days after parturition.

The period from parturition to the time of the 1st postpartum ovulation and the length of the 1st sexual cycle were positively correlated with the number of follicular waves during the periods. About 81% of the first postpartum follicular waves and 88% of the 1st ovulations occurred in the ovary contralateral to the previous pregnant uterine horn. The differences disappeared after the 1st postpartum ovulation. Average values of milk progesterone were discovered during the 1st and 2nd sexual cycles at day 5–7 (5.9 ± 4.78 and 6.3 ± 5.16 ng/ml) and at day 10–12 (5.6 ± 5.83 and 11.4 ± 7.74 ng/ml).

Follicular wave, ovulation, luteal structure, laterality

A large variety of postpartum ovarian activity in cows was discovered using rectal palpation and morphological investigation after slaughter. Simultaneous occurrence of growth, maturation, luteinization and regression in follicular population is described by Morrow et al. (1966), Wagner and Hansel (1969), Schirar and Martinet (1982), Dufour and Roy (1985). Various quality and lifespan of the first postpartum luteal structures are cited by Lauderdale et al. (1968), Duby et al. (1985), Rutter and Randel (1985). Development of follicles influence the quality and lifespan of following luteal structures (Smith, 1986, Inskeep et al., 1988). For this reason continual observation of follicular population is important for the understanding of a resumption of sexual cycle in postpartum cows.

Ultrasound imaging makes it possible to observe the dynamics of follicular development. Pierson and Ginther (1987a), Rojamahendran and Walton (1988) state sequential patterns of development and regression (follicular waves) during sexual cycle in cattle. Likewise dominant follicles and follicular waves are described before the first postpartum ovulation and during the following sexual cycle in dairy (Rojamahendran and Taylor 1990, Savio et al. 1990) and beef (Braden et al., 1986; Murphy et al. 1990) cows.

The objectives of our study were to characterize ovarian activity in cows using ultrasound scanning and milk progesterone assay from day 9–10 postpartum to the second postpartum ovulation.

Materials and Methods

Eighteen pluriparous dairy cows (Norwegian cattle) calving between August 26 and October 25 were included in the experiment. Two cows with pathological conditions (ovarian cysts, retentio secundinarum and endometritis) were excluded by the end of the experiment. Grass silage and concentrates formed principal part of diet. Calves were removed immediately after parturition. Cows were milked and were observed for estrus twice daily.

The cows were regularly investigated by rectal palpation and transrectal ultrasonography (Scanner 400 or 403, PIE Medical, The Netherlands) twice a week, ovarian structures and uterine horns were printed in different planes by video copy processor (Model P61E, Mitsubishi, Japan) and follicles > 3 mm in diameter, corpora lutea and width of uterine horns (approximately in a third of its length) were evaluated. Ovarian structures were individually identified by reference to their position and diameter in sequential images. Gradual growth of a dominant follicle (follicle in diameter at least 2 mm more than other follicles) was considered a follicular wave. Day after estrus was determined as the time of ovulation. If estrus was not observed, day 2 after investigation of the largest dominant follicle, followed by disappearance of the follicle and formation of a CL, was determined as the time of ovulation. The largest follicle at day 9–10 after calving was considered as the 1st postpartal dominant follicle. The time from which the width of uterine horns did not decrease gradually and distinctly was determined as the time of clinical involution of uterus.

The samples of whole milk were taken three times a week from day 9–10 after calving to the end of the 2nd postpartal sexual cycle and they were stored at -20°C until they were assayed for progesterone by RIA. Student t-test was used for statistical evaluation.

Results

The number of follicular waves before and after the 1st postpartal ovulation, total number of follicles, time of the 1st ovulation, length of the 1st postpartal sexual cycle and time of clinical involution of uterus are included in Table 1. One follicular wave before the 1st ovulation occurred in 9 of 10 cows which ovulated before day 20 post partum. Two follicular waves were discovered in 1 cow which ovulated before day 20 and in all cows which ovulated later. Two follicular waves during the 1st sexual cycle were discovered in 8 of 9 cows with the 1st sexual cycles shorter than 20 days. One follicular wave occurred during one short sexual cycle. Three follicular waves were discovered in 5 of 7 cows with longer 1st sexual cycles, two and four follicular waves occurred in the remaining 2 cows. The mean length of the 1st postpartum sexual cycle in cows which ovu-

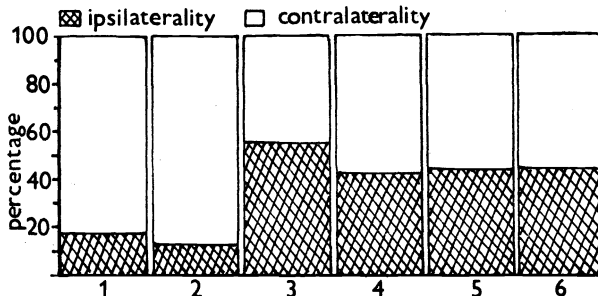


Fig. 1. Laterality of follicular waves and ovulations in postpartum cows.

- 1 — 1st follicular wave: previous pregnant uterine horn
- 2 — 1st ovulation: previous pregnant uterine horn
- 3 — follicular waves during 1st sexual cycle: previous pregnant uterine horn
- 4 — follicular waves during 1st sexual cycle: cyclical CL
- 5 — 2nd ovulation: previous pregnant uterine horn
- 6 — 2nd ovulation: cyclical CL

lated before and after day 20 post partum was 17.8 ± 4.61 and 22.2 ± 3.55 days.

The first contralateral postpartal follicular wave and the 1st contralateral postpartal ovulation in relation to the previously pregnant uterine horn was discovered in 13 of 16 (81%) and in 14 of 16 (88%) cows. Differences in laterality of follicular waves and ovulations decreased after the 1st postpartal ovulation (Fig. 1).

The mean concentrations of milk progesterone at day 5–7 and 10–12 of the 1st and 2nd sexual cycles are included in table 2. Significantly ($p < 0.05$) higher concentration was discovered at day 10–12 of the 2nd postpartum sexual cycle (11.4 ± 7.74 ng/ml) in comparison with concentration in the same period of the previous sexual cycle (5.6 ± 5.83 ng/ml).

Table 1

Number of follicular waves from calving to the 1st ovulation (A) and during the 1st sexual cycle (B), number of subordinate follicles from calving to the 1st ovulation (C) and during the 1st sexual cycle (D), interval (day pp) from calving to the 1st ovulation (E) and to the complete uterine involution (F), and length (days) of the 1st sexual cycle (G)

A	B	C	D	E	F	G
1.5 ± 0.52	2.4 ± 0.72	1.9 ± 1.04	1.8 ± 1.11	17.9 ± 5.04	22.6 ± 4.34	19.4 ± 4.66

Mean \pm s. d.

Table 2

Concentration of milk progesterone at day 5–7 and 10–12 of the 1st and 2nd postpartum sexual cycles in cows

	1st sexual cycle	2nd sexual cycle
Day 5–7	5.9 ± 4.78	6.3 ± 5.16
Day 10–12	5.6 ± 5.83 $p < 0.05$	11.4 ± 7.74

Mean \pm s. d.

Discussion

Well-balanced numbers of subordinate ovarian follicles > 3 mm in diameter before and after the 1st ovulation suggest a similar follicular activity in these periods. The largest follicle at day 9–10 after calving was considered the 1st postpartum dominant follicle even if Savio et al. (1990) discovered the 1st dominant follicle already at day 6.8 ± 1.8 post partum. One follicular wave we discovered in cows before the 1st ovulation which occurred before day 20 post partum. Two follicular waves were discovered in cows which ovulated later. Two follicular waves during the 1st postpartum sexual cycle occurred in most cows with the sexual cycle shorter than 20 days. Three follicular waves occurred during longer first postpartum sexual cycles. Our results stand comparison with normal sexual cycles in which the number of follicular waves relate to the length of the sexual cycles and in which length of follicular waves are approximately 1 week (Pierson and Ginther 1987a; Rojamahendran and Walton 1988). Rojamahendran and Tylor (1990) state 2 follicular waves during the

1st postpartum cycle in 18 of 21 cows. Periods among investigation (3 and 4 days) prevented to evaluate the length of follicular waves in our experimnt.

Term of the 1st postpartum ovulation 17.9 (11–28) days is shorter than it is usually discovered in crossbreds of Bohemian Pied and Holstein-Friesian cows (e.g. average value 27.74 days is stated by Kudláč and Vlček (1970) but the term is comparable with the results of other authors (Morrow et al. 1969; Garcia and Larson 1982; DUBY et al. 1985; SAVIO et al. 1990). We discovered a shorter length of the 1st postpartum sexual cycle in cows which ovulated before day 20 post partum than in cows which ovulated later. Some of the 1st postpartum luteal structures in cows having a short sexual cycle represented in ultrasound image corpus hemorrhagicum (diameter < 20 mm, low echogenity of luteal tissue, sometimes cavity) throughout its lifespan. Shorter 1st postpartum sexual cycles, the relation of the length of the 1st sexual cycle to the term of the 1st postpartum ovulation, and different quality of the 1st postpartum corpus luteum are described by Morrow et al. (1966), Lauderdale et al. (1968), Garcia and Larsson (1982), DUBY et al. (1985), Rutter and Randel (1985), Schallenberger (1985). Slightly higher levels of serum progesterone (0.6–1.0 ng/ml) are often accompanied by small atypical luteal structures in ovaries at day 20–25 post partum (Doležel et al. 1991). Practically the same average levels of milk progesterone (5.94 and 6.25 ng/ml) at day 5–7 and different levels at day 10–12 post partum (5.56 and 11.38 ng/ml) in the 1st and the 2nd postpartum sexual cycle support clinical findings in our experiment. Perry et al. (1991) state similar concentrations of serum progesterone during the first 4 days in the 1st and 2nd postpartum sexual cycles but they describe higher concentration from day 5 to 8 of the 2nd sexual cycle.

We registered 81% of the 1st postpartum follicular waves and 88% of the 1st ovulation occurring in contralateral ovary in relation to the previously pregnant uterine horn and the differences disappeared after the 1st postpartum ovulation. Inhibitory influence of corpus luteum graviditatis or pregnant uterine horn to early postpartum activity of ipsilateral ovary are shown by Morrow et al. (1968), Schirar and Martinet (1982), Bellin et al. (1984), Pierson and Ginther (1987b, c). Likewise, Kotík (1990) reports higher percentage of cows with first ovulation on the contralateral ovary in relation to the previous pregnant uterine horn. The differences are more distinct in primiparous cows with left-side previous pregnancy. Our results suggest more distinct inhibitory effect of previously pregnant uterine horn to early postpartum follicular development in comparison with effect of cyclical corpus luteum. On the other hand Rajamahendran and Taylor (1990) did not discover any relation of pregnancy to laterality of the 1st postpartum ovulation.

Ovariální aktivita v ultrazvukovém zobrazení a koncentrace progesteronu v mléce u krav v poporodním období

18 pluriparních mléčných krav bylo vyšetřováno ultrazvukem 2krát týdně od 9.–10. dne po porodu do 2. ovulace. Třikrát týdně byly odebírány vzorky mléka pro stanovení progesteronu RIA metodou. Před 1. poporodní ovulací a v průběhu 1. pohlavního cyklu jsme zjistili $1,9 \pm 1,09$ a $1,8 \pm 1,11$ podřízených folikulů, $1,5 \pm 0,52$ a $2,4 \pm 0,72$ folikulárních vln. První ovulace proběhla $17,9. \pm 5,04$. den po porodu, délka 1. pohlavního cyklu činila $19,4 \pm 4,66$

dní a klinická involuce dělohy byla zakončena $22,6 \pm 4,34$. den po porodu. Délka periody od porodu do 1. ovulace i délka 1. pohlavního cyklu pozitivně korelovala s počtem folikulárních vln v průběhu uvedených period. 81 % prvních poporodních folikulárních vln a 88 % prvních ovulací proběhlo na kontralaterálních ováriích k předtím březímu děložnímu rohu. Rozdíl v počtu folikulárních vln a ovulací v závislosti na lateralitě se po 1. poporodní ovulaci vyrovnaly. V průběhu 1. a 2. poporodního pohlavního cyklu jsme zjistili hodnoty progesteronu 5.–7. den $5,9 \pm 4,78$ a $6,3 \pm 5,16$ ng/ml, 10.–12. den $5,6 \pm 5,83$ a $11,4 \pm 7,74$ ng/ml.

Овариальная активность в ультразвуковом изображении и концентрация прогестерона в молоке коров в послеродовой период

Исследовали 18 многорожавших коров ультразвуком 2 раза в неделю с 9 - 10 дня после отела до 2 овуляции. Три раза в неделю проводили отбор проб молока с целью определения прогестерона методом PIA. Перед 1 послеродовой овуляцией и в ходе 1 полового цикла нами были установлены $1,9 \pm 1,09$ и $1,8 \pm 1,11$ подчиненных фолликулов, $1,5 \pm 0,52$ и $2,4 \pm 0,72$ фолликулярных волн. Первая овуляция проходила $17,9 \pm 5,04$ суток после отела, продолжительность 1 полового цикла достигала $19,4 \pm 4,66$ суток и клиническая involуция матки была завершена $22,6 \pm 4,34$ суток после отела. Продолжительность периода от отела до 1 овуляции и продолжительность 1 полового цикла находились в позитивной корреляции с численностью фолликулярных волн в течение приведенных периодов. 81 % первых послеродовых фолликулярных волн и 88 % первых овуляций протекали на контраратеральных овариях к забеременевшему до этого углу матки. Разница численности фолликулярных волн и овуляций в зависимости от латеральности после 1 послеродовой овуляции исчезла. В ходе 1 и 2 послеродовых половых циклов нами были установлены величины прогестерона на 5 - 7 сутки $5,9 \pm 4,78$ и $6,3 \pm 5,16$ нг/мл, 10 - 12 сутки - $5,6 \pm 5,83$ и $11,4 \pm 7,74$ нг/мл.

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