Western Dairy News

for the West, about the West, from the West

How soon after calving do cows show heat and evidence of first ovulation?

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Twelve years ago, a researcher at Utah State University used radiotelemetry (HeatWatch, originally developed by DDX Inc., Denver, CO), blood progesterone, and visual heat detection to characterize post-calving ovulations in 19 multiparous lactating Holstein cows. From the progesterone and radiotelemetry data, almost 42 percent of all first ovulations seen after calving were "silent" – that is, not accompanied by a standing event.

Recognizing that this data is from a small number of cows and the fact there is heavy usage of once-daily heat detection and artificial insemination on many Western dairies, we recently conducted a study to answer the question, "How soon after calving do cows show heat and evidence of first ovulation?"

It is important to understand the prevalence of timed A.I. usage following heat detection on Western U.S. dairies. Lydia Moeller at American Breeders Service and her co-workers at the University of Idaho and University of Florida evaluated records (231,288 cows and 649,495 matings) from 85 Holstein dairies in four geographic regions over a 12-month period. They reported regional differences regarding the use of timed A.I., with the lowest percentage (about 25 percent) of all inseminations occurring as a result of timed A.I. in the Western U.S. Conversely, those dairies also exhibited the highest percentage (about 75 percent) of inseminations following an observed heat, likely as determined with the use of once-daily tail chalk or tail paint application and reading.

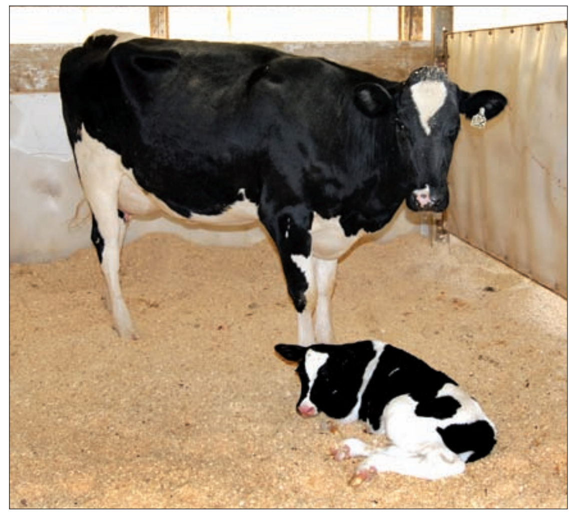
The take home message here is two-fold. First, on a regional basis, many cows are not enrolled in presynchronization and timed A.I. programs. Second, learning more about early postpartum heat characteristics may help heat detection-based A.I. programs achieve greater success.

In our study, healthy cows (50 total; 31 multiparous and 19 primiparous) with no previous history of dystocia or disease were continuously monitored with HeatWatch II (CowChips LLC, Manalapan, NJ) from day 14 to approximately day 49 postpartum. HeatWatch II is a 24-hour heat detection system that includes a transmitter contained in a patch that is glued to the hair of the tailhead, a base station, an access point, and supporting software. When activated for a minimum of two seconds, the transmitter emits a radiowave that includes transmitter ID number, date, time, and duration of activation.

Cows were housed in a combination free stall and open lot facility in Idaho and were fed a TMR formulated to meet or exceed the nutritional requirements for lactating Holsteins. Cows were milked three times per day and annual average milk yield was over 27,000 pounds per cow. Cows were restrained in headlocks for 1.5 hours daily to facilitate management.

Cows were determined to be in heat when three or more standing events were recorded by the HeatWatch II software in any 4-hour time period. Onset of heat was identified as the first recorded standing event. Duration of heat was defined as the interval in hours from the first standing event to the last standing event in a heat period. Intensity of heat was defined as the number of standing events in a heat period.

To confirm ovulation, blood samples (taken once weekly starting on day 14 after calving) were analyzed for progesterone concentration. Why progesterone? Progesterone concentration in blood is associated with events of the estrous cycle as concentration is low (<1.0 ng/mL) for two days prior to heat and remains low for approximately two to three days after heat. The corpus luteum, which forms in the same location on the ovary as the ovulated follicle, produces progesterone. Therefore, in our study, cows were classified as not having ovulated (<1 ng/mL) or as having ovulated (≥1 ng/mL) based on progesterone concentration. Weekly ultrasonography was also used to visualize ovarian structures.



In cows that showed heat, days to first ovulation was determined from HeatWatch II data (onset of heat) followed by evidence of high progesterone in a successive blood sample. In cows that did not show heat associated with ovulation, the time of ovulation was estimated to be four days before high progesterone was detected.

Among our findings were that first ovulation was associated with heat in only five cows, and it occurred at approximately 28 days postpartum (range 17 to 40 days). The average duration of heat was six hours (range 3 to 12 hours) and average intensity was 18 standing events (range 4 to 26). Average days to first ovulation in this study is similar to that of previous published studies (range 21 to 29 days).

In a study by Virginia Tech researchers using HeatWatch to investigate the timing of A.I. relative to the onset of heat, a similar average duration of heat (seven hours) was found, but average intensity was lower (eight standing events). The specific reason for the difference in average intensity between the studies is unknown, but it may be related to housing surface, as cows with greater access to drylot and pastures are reported to exhibit more mounting and standing behavior as compared to cows with limited access.

High rate of silent ovulation

Based on progesterone concentrations ≥1 ng/mL, 38 cows were determined to have had a first ovulation without evidence of heat (silent ovulation). This appears to be a much greater percentage (38/43; 88.4 percent) of silent ovulations compared with the previously mentioned data from Utah State University (42 percent).

What may have caused the difference in results between the two studies? In the Utah State University study cows were classified as being in heat if there was evidence of a single standing event, versus the criterion of three standing events in four hours used in the present study. This may account for the apparent difference in percentage of silent ovulations reported between the studies. In cows that did not display evidence of heat, the first postpartum ovulation was estimated to occur at approximately 25 days (range 10 to 49 days).

Six cows did not show evidence of ovulation based on blood progesterone concentrations and did not show evidence of heat based on HeatWatch II data. The incidence of anovulatory anestrus on this dairy appeared to be lower (8.5 percent) than previously reported for cows at a similar stage of lactation (20 to 40 percent). An additional cow showed evidence of heat the day before removal from the study (day 48), but data were not included in the results because ovulation could not be verified with a plasma progesterone sample.

What about potential effects of body condition loss and (or) milk production on days to first ovulation as verified by plasma progesterone? Recognizing that excessive loss of body condition after calving is associated with increased days to first ovulation, body condition scores (BCS) were recorded for individual cows at enrollment and completion of the study to monitor BCS loss. Cows with evidence of a first ovulation were categorized into two groups based on BCS loss (0.5 BCS loss or greater, and less than 0.5 BCS loss) to investigate a possible effect of BCS loss on days to first ovulation. Loss of body condition did not affect the interval to estimated first ovulation without heat or first ovulation with heat.

Monthly milk weights were measured by a DHIA supervisor. Following DHIA records processing and laboratory analysis of milk samples, results were transmitted electronically from the records processing center to the dairy computer, where all records were readily available.

To investigate the effect of milk production on days to first ovulation, cows with evidence of first ovulation with or without heat activity were placed into two milk production groups, less than 88 pounds per day and 88 or more pounds per day, based on the average of the first two test weights. Level of milk production did not affect the interval to estimated first ovulation without heat or first ovulation associated with heat.

When analyzing dairy records, it is generally not fair to compare first lactation animals with older animals. Therefore, cows were separated into two groups, primiparous and multiparous, to investigate a possible effect of parity on days to first ovulation. No difference was found between these groups and days to first ovulation.

Previous reports have shown an association between blood nutritional markers and reproductive performance. Therefore, we investigated the relationship between the resumption of ovarian activity and blood nutritional markers including nonesterified fatty acids (NEFA), Beta-hydroxybutyrate (BHBA), glucose, and cholesterol.

For this analysis, cows were divided into two treatment groups, early ovulators (cows that ovulated at 25 DIM or less) and late ovulators (cows that ovulated at more than 25 DIM) based on plasma progesterone concentration and ovarian status using ultrasonography. The average interval to first ovulation for early ovulators was nearly 17 days, and for late ovulators was nearly 35 days. Interestingly, on day 14 postpartum, the average BCS was greater for early ovulators than late ovulators.

Increased NEFA and BHBA are associated with increased disease risk and reduced reproductive performance. Non-esterified fatty acids and BHBA are indicative of energy balance, as NEFA reflects the magnitude of fat mobilization, while BHBA reflects the completeness of fat "burning" in the liver. When the supply of NEFA is greater than the liver's ability to completely burn fatty acids to supply energy, the amount of ketones (BHBA) produced increases. Ketones (BHBA) serve as an alternate fuel for many tissues, thereby conserving glucose for milk production. There was no difference in NEFA or BHBA between early and late ovulators in our study. Across all weeks, average glucose concentrations were greater in early ovulators than late ovulators.

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Cholesterol level may be a clue

Cholesterol is known to gradually increase after calving, and in general, reflects fat mobilization that occurs during this time. As expected, average blood cholesterol increased over time for both early and late ovulators in our study. However, average cholesterol concentrations between weeks two and three were less for early ovulators than for late ovulators. This is an intriguing finding as 1) cholesterol is a building block for the production of testosterone (and ultimately estrogen) by the ovary, and 2) previous studies reported earlier ovarian steroidogenesis in cows that conceived earlier postpartum. Therefore, the lower blood cholesterol seen in early ovulators may be indicative of earlier ovarian activity.

Further analysis of our data showed that greater blood glucose postpartum and/or lower cholesterol increased the probability of first ovulation by day 21 after calving in lactating dairy cows. Given our small data set, the cholesterol and glucose results certainly provide food for thought regarding resumption of reproductive function. Nevertheless, further research with a larger number of animals (and more samples over time) must be conducted to establish a relationship between cholesterol, glucose and interval to first ovulation postpartum.

How can we use all this information? First, it has been known for many years that cow fertility is directly related to health during the early postpartum period. Factors negatively influencing the resumption of cyclicity include drastic changes in body condition during the dry period and early postpartum, milk fever, ketosis, displaced abomasum, ruminal acidosis, retained placenta, metritis, ovarian cysts, and lameness. Therefore, it is imperative for dairy producers to implement effective transition cow management programs to prevent and effectively manage these problems.

Second, dairy cattle experience negative energy balance during early lactation because feed intake is not able to support milk yield and maintenance. The magnitude and duration of negative energy balance depends more on feed (dry matter) intake than milk yield.

Watch dry matter intake closely

Several investigators have hypothesized that the severity of negative energy balance delays the resumption of the first postpartum ovulation, while researchers at Cornell University reported a 14-day lag period between the lowest level of negative energy balance and first postpartum ovulation. Dry matter intake during the early postpartum affects energy balance, which ultimately affects reproductive performance. Therefore, dairy managers should focus on maximizing dry matter intake with fresh, palatable, high quality feed during the early postpartum period.

In healthy, well-managed cattle progesterone and Heatwatch II data provide evidence that first ovulation postpartum occurs within approximately 28 days after calving. However, the majority of first ovulations (88.4 percent) were not associated with heat activity. Taken together with the short average duration of heat (six hours) associated with first ovulation, it is evident that detection of the first heat postpartum may be challenging.

Consequently, dairy herds that are currently using a heat detection-based management strategy should consider the addition of a presynchronization program to facilitate identification of cycling animals (likely at the heat associated with second ovulation) and to program or anticipate animals for artificial insemination after the end of the voluntary waiting period.

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