

Postpartum anestrus of beef cows: importance and evaluation

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Abstract

Duration of anestrus period and infertility in postpartum suckled beef cows impact reproductive performance and efficiency of cow-calf operations. Percent cows calving in first 21 days of calving season is higher for herds with shorter (average 50 days) rather than longer (average 80 days) length of postpartum anestrus. Because primiparous cows may have a prolonged postpartum anestrus compared to similarly managed multiparous cows, breeding replacement heifers before mature cows, sometimes referred to as providing a heifer lead time, may increase likelihood that primiparous cows have resumed fertile estrous cycles and have opportunity to conceive during first 21 days of breeding season subsequent to first parturition. While having a 42 day heifer lead time resulted in greater pregnancy success and average weaning weight compared to no lead time, ~ two-thirds of improvement in outcomes was realized with a heifer lead time of only 21 days. Determining length of postpartum anestrus following first and subsequent pregnancies can assist veterinarians and producers to develop optimal herd management strategies.

Keywords: Postpartum, anestrus, infertility, bovine

Introduction

Postpartum period of infertility is time from calving until a cow resumes fertile estrous cycles and can become pregnant again. There are 2 important events place during postpartum period; uterus must return to a pre-pregnancy state and the hormones that control estrous cycle must resume normal function to allow fertile ovulations. During postpartum period, cow has highest nutritional demand of the year as lactation is initiated and daily milk production peaks at ~ 60 - 90 days postpartum, uterus undergoes involution, and fertile estrous cycles are resumed, enabling mating and conception for subsequent calving season.

Uterus decreases in weight from 20 - 25 pounds at parturition to < 1 pound by 25 days postpartum. During first few days after parturition, uterus is normally thick-walled and tonic, but if infection is present, it may have a thinner wall and atonic. Uterine involution is not affected by suckling and is similar in beef and dairy cattle. Normal involution process begins shortly after parturition, upper two-thirds of caruncles undergo necrosis due to loss of blood supply and necrotic tissue is sloughed and expelled as part of the uterine lochia.¹ Uterus usually is near nonpregnant size by 3 - 4 weeks postpartum, with previously pregnant horn still slightly larger.² Parturition is followed by an ~ 3 week interval when conception is not possible. Estrus and ovulation seldom occur together during this period and, if fertilization occurred and embryo reached uterus, placentation would be virtually impossible. Period of infertility is followed by 2 - 3 weeks when fertility is possible, but not optimal.² Uterine involution appears not to be a barrier to fertility after 5 - 6 weeks postpartum in cows, unless delayed by inflammation or infection.²

Anestrus is major component of postpartum infertility and is affected by several minor factors: season, breed, parity, dystocia, presence of a bull, and carryover effects from previous pregnancy and 2 major factors (suckling and nutrition).³⁻⁶ As reported earlier,⁵ for spring-calving herds, duration of postpartum anestrus decreased with increasing Julian day.⁷ Season may truly have a role in modifying duration of postpartum anestrus through light stimulation of pineal gland.⁸ Presumably, differences in duration of postpartum anestrus associated with season or Julian day could also be related to quality and quantity of available forage.

Suckling has a dramatic effect on postpartum interval. In suckled cows, first ovulation is delayed to 30 days or more postpartum. Cows that have their calves weaned at birth have shorter postpartum interval than do cows that are suckled. If calves are weaned at some time after birth but before estrous cycles begin, cows will return to estrus in a few days. Postpartum intervals can be decreased by complete

weaning and to a less predictable extent, by short-term weaning (48 hours) or restricted suckling.⁹⁻¹² Conception success is lower up to 40 days after parturition, as function of first corpus luteum as measured by serum progesterone concentrations is less than subsequent cycles, and with reduced estrus signs.³ Normal corpus luteum function during an early postpartum estrous cycle can be obtained by pretreatment with a progestin.¹³

A cow's nutritional demand is highest of production cycle during postpartum period primarily due to demands of lactation, which peaks at ~ 60 - 90 days after calving.^{14,15} Quantity and quality of feed intake, nutrient reserves stored in the body and competition for nutrients from other body functions besides reproduction (lactation, growth, etc.) are all factors that affect length of time required to resume cycling. Body weight and condition score, are good indicators of energy status and rebreeding performance after calving. Inadequate precalving and/or postcalving energy or protein nutrition extends length of postpartum anestrus.

Postpartum anestrus lasts an average of 55 - 65 days for multiparous cows in good body condition (longer if low body condition).^{7,16-19} Regardless, recognize that full consideration of average postpartum length means that ~ 50% of cows in good body condition have not resumed fertile cycles by 55 - 65 days. Postpartum anestrus lasts an average of 80 - 100 days for primiparous cows in good body condition.^{20,21} Dystocia will increase length of postpartum anestrus. Adverse effects of dystocia can be overcome at least partially by providing early obstetrical assistance.

Importance of length of anestrus

There are several reproductive constraints in beef cattle production. First is that when a fertile cow and a fertile bull mate, about 60 - 70% of time a viable calf will be detected at determination of pregnancy status during midpregnancy.²² However, ~ 30% of time following a fertile mating, early embryo dies within first 13 days. When an embryo is lost before maternal recognition of pregnancy (~ 13 days after ovulation), cow will display estrus and ovulate an oocyte about 21 days after her last ovulation and have another 60 - 70% probability of achieving and maintaining pregnancy.²² Another constraint is that there are 283 days of pregnancy and 365 days in a year, which means that a cow must achieve a viable pregnancy within 82 days after calving in order to maintain a 365 day calving interval.

Based on these 2 constraints, best herd reproductive performance that can be expected would be depicted with a histogram where 65% of the herd becomes pregnant in first 21 days. This would indicate that nearly every cow has resumed fertile estrous cycles by the 21st day of breeding season and bulls are able to successfully mate cows. Cows that are fertile during first 21 days of breeding season but fail to maintain a pregnancy from first mating, are expected to express estrus and ovulate approximately 21 days after their first ovulation and will have another 60 - 70% probability of establishing a viable pregnancy which results in another 23% of herd becoming pregnant in the second 21 days of the breeding season. Finally, if cows fail to establish viable pregnancies after 2 fertile matings, ~ 60 - 70% of remaining cows become pregnant in the third 21 days of breeding season, leaving the herd with 5% nonpregnant cows after a 63 day breeding season (Figure).

In order to investigate effect of length of postpartum infertility on percentage of cows in a herd that conceive and maintain a viable pregnancy during first 21 days of breeding season, average age at weaning and total weight of calves weaned over a 10 year interval, a deterministic, dynamic systems model was developed²³ to compare 22 combinations of multiparous and primiparous postpartum anestrus length. Model compared herds that averaged 50, 60, 70, and 80 day postpartum anestrus for multiparous cows and 50, 60, 70, 80, 90, 100, and 110 day postpartum anestrus for primiparous cows. Percent cows calving in first 21 days of calving season is higher for herds with shorter (average 50 days) rather than longer (average 80 days) length of postpartum anestrus.²³ Earlier calving cows produce heavier calves at weaning, as demonstrated by a model that calculated weaning weights that averaged 65 lbs heavier for herds with 50 day average duration of postpartum anestrus compared to herds with 80 day average duration of postpartum anestrus.²³ In addition, cows with a 70 day or greater length postpartum anestrus were less likely to become pregnant in a 63 day breeding season.²³

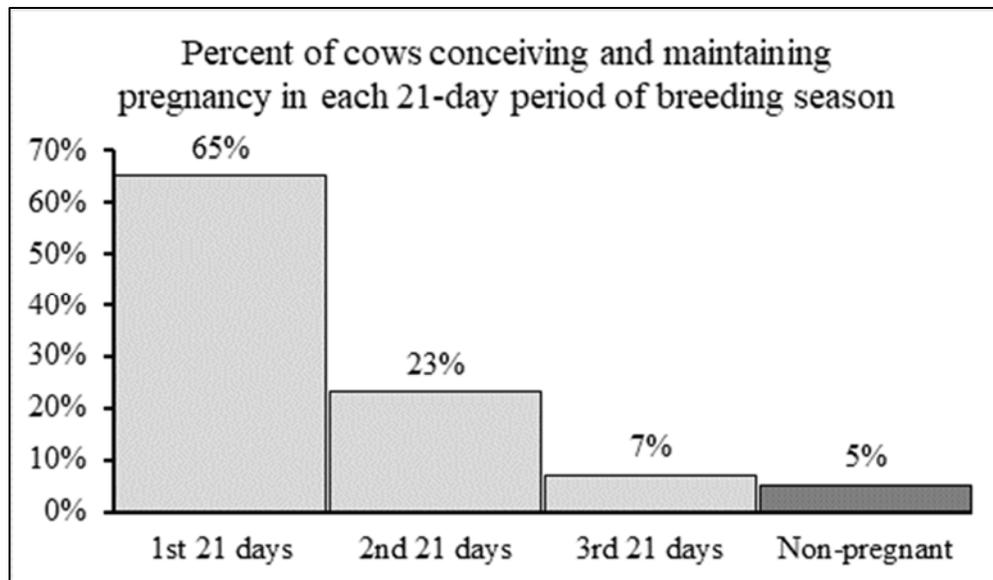


Figure. Histogram of the percentage of cows that conceive and maintain a viable pregnancy if nearly all cows in the herd ovulate a fertile oocyte during the first 21st days of breeding season and are mated by fertile bulls and 60 - 70% of available (nonpregnant) cows conceive and maintain a viable pregnancy in each subsequent 21 day breeding period.

Because postpartum anestrus lasts longer in primiparous cows than similarly managed multiparous cows, nulliparous heifers must be bred to calve before multiparous cows to enable them to ovulate a fertile oocyte during first 21 days of their second breeding season. Some cattle production consultants recommend that cow-calf producers breed nulliparous cows before primiparous and multiparous cows, sometimes referred to as providing a heifer lead time. A deterministic, dynamic systems model was used to evaluate herds with an average 60 day postpartum anestrus for multiparous cows and one of 42 combinations of 60, 70, 80, 90, 100, or 110 day average postpartum anestrus for primiparous cows and 0, 7, 14, 21, 28, 35, or 42 day heifer lead times.²⁴ Whereas having a 42 day heifer lead time resulted in greater pregnancy success and average weaning weight compared to shorter lead times, approximately two-thirds of improvement in outcomes was realized with a heifer lead time of only 21 days.²⁴ In addition, primiparous cow cohorts with average length of postpartum anestrus of 70 days or longer should be bred to calve ahead of cows or they will contribute to negative annual reproductive momentum and an unacceptable percentage of primiparous cows will fail to become pregnant in a 63 day breeding season.²⁴

Evaluation of length of anestrus

Duration of postpartum anestrus can be a major contributing factor to herds with poor reproductive performance and low calf weight weaned per cow exposed over time and should be a rule-out when investigating lower than desired reproductive efficiency. It appears that maintaining an average duration of postpartum anestrus for multiparous cows to < 60 days results in improved production outcomes when compared to a longer postpartum anestrus. In addition, herds with a shorter duration of postpartum anestrus are more resilient to negative effects of various unpredictable and sporadically occurring adverse production events.

Quantifying a herd's average length and range of postpartum anestrus could be useful to veterinarians seeking to improve reproductive management and performance of beef cow-calf herds. An estimate of average and range of anestrus duration could be determined by selecting a sample of cows in a herd that have calved at various time points in calving season and monitoring them for estrus signs and behavior to establish resumption of estrous cycles. Determining duration of postpartum anestrus for age-specific cohorts such as primiparous versus multiparous cows may have additional value. Several

technological aids (heat-detection patches, chin-ball markers, and electronic, indirect monitoring technologies) were developed to assist with monitoring cattle for onset of estrus. Many of these technologies are inexpensive and are easily applied to cattle.

Conflict of interest

There are no conflicts of interest to declare.

References

1. Gier HT, Marion GB: Uterus of the cow after parturition: involutinal changes. *Am J Vet Res* 1968;29:1-23.
2. Kiracofe GH: Uterine involution: Its role in regulating postpartum intervals. *J Anim Sci* 1980;51(Suppl. 2):16-28.
3. Short RE, Bellows RA, Staigmiller RB, et al: Physiological mechanisms controlling anestrus and infertility in postpartum beef cattle. *J Anim Sci* 1990;68:799-816.
4. Viker SD, Larson RL, Kiracofe GH, et al: Prolonged postpartum anovulation in mastectomized cows requires tactile stimulation by the calf. *J Anim Sci* 1993;71:999-1003.
5. Yavas Y, Walton JS: Postpartum acyclicity in suckled beef cows: A review. *Theriogenology* 2000;54: 25-55.
6. Crowe MA: Resumption of ovarian cyclicity in post-partum beef and dairy cows. *Reprod Dom Anim* 2008;43(Suppl 5): 20-28.
7. Cushman RA, Allan MF, Thallman RM, et al: Characterization of biological types of cattle (Cycle VII): Influence of postpartum interval and estrous cycle length on fertility. *J Anim Sci* 2007;85:2156-2162.
8. Sharpe PH, Gifford DR, Flavel PF, et al: 1986. Effect of melatonin on postpartum anestrus in beef cows. *Theriogenology* 1986;26:621-629.
9. Shively TE, Williams GL: Patterns of tonic luteinizing hormone release and ovulation frequency in suckled anestrus beef cows following varying intervals of temporary weaning. *Domest Anim Endocrinol* 1989;6:379-387.
10. Stagg K, Diskin MG, Sreenan JM et al: Follicular development in long-term anoestrous suckler beef cows fed two levels of energy postpartum. *Anim Reprod Sci* 1995;38:49-61.
11. Quintans G, Vazquez AI, Weigel KA: Effect of suckling restriction with nose plates and premature weaning on postpartum anestrus interval in primiparous cows under range conditions. *Anim Reprod Sci* 2009;116:10-18.
12. Vasconcelos JL, SaFilho OG, Perez GC, et al: Intravaginal progesterone device and/or temporary weaning on reproductive performance of anestrus crossbred Angus x Nelore cows. *Anim Reprod Sci* 2009;111:302-311.
13. Ramirez-Godinez JA, Kiracofe GH, Schalles RR, et al: Endocrine patterns in the postpartum beef cow associated with weaning: A comparison of the short and subsequent normal cycles. *J Anim Sci* 1982;55:153-158.
14. Grings EE, Roberts AJ, Geary TW, et al: Milk yield of primiparous beef cows from three calving systems and varied weaning ages. *J Anim Sci*. 2008;86:768-779.
15. Tedeschi LO, Fox DG: Predicting milk and forage intake of nursing calves. *J Anim Sci* 2009;87:3380-3391.
16. Rutter LM, Randel RD: Postpartum nutrient intake and body condition: Effect on pituitary function and onset of estrus in beef cattle. *J Anim Sci* 1984;58:265-274.
17. Houghton PL, Lemenager RP, Horstman LA, et al: Effects of body composition, pre- and postpartum energy level and early weaning on reproductive performance of beef cows and preweaning calf gain. *J Anim Sci* 1990;68:1438-1446.
18. Perry RC, Corah LR, Cochran RC, et al: Influence of dietary energy on follicular development, serum gonadotropins, and first postpartum ovulation in suckled beef cows. *J Anim Sci* 1991;69:3762-3773.
19. Lents CA, White FJ, Ciccioi NH, et al: Effects of body condition score at parturition and postpartum protein supplementation on estrous behavior and size of the dominant follicle in beef cows. *J Anim Sci* 2008;86:2549-2556.
20. Ciccioi NH, Wettemann RP, Spicer LJ, et al: Influence of body condition at calving and postpartum nutrition on endocrine function and reproductive performance of primiparous beef cows. *J Anim Sci* 2003;81:3107-3120.
21. Berardinelli JG, Joshi PS: Introduction of bulls at different days postpartum on resumption of ovarian cycling activity in primiparous beef cows. *J Anim Sci* 2006;83:2106-2110.
22. BonDurant, RH: Selected diseases and conditions associated with bovine conceptus loss in the first trimester. *Theriogenology* 2007;68:461-473.
23. Shane DD, Larson RL, Sanderson MW, et al: A deterministic, dynamic systems model of cow-calf production: The effects of the duration of postpartum anestrus on production parameters over a 10 year horizon. *J Anim Sci* 2017;95:1680-1695.
24. Shane DD, Larson RL, Sanderson MW, et al: A deterministic, dynamic systems model of cow-calf production: The effects of breeding heifers before mature cows over a 10 year horizon. *J Anim Sci* 2017;95:4533-4532.