Effect of the previously gravid uterine horn and postpartum interval on follicular diameter and conception rate in beef cows treated with estradiol benzoate and progesterone

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ABSTRACT: An experiment was performed to evaluate the effect of the side of ovulation with respect to the previously gravid uterine horn on fertility of cows inseminated at one of two periods postpartum. All cows were treated with an intravaginal progesterone insert for 7 d and received estradiol benzoate (2 mg, i.m.) at the time of device insertion, prostaglandin F2α (25 mg, i.m.) at the time of device removal, and estradiol benzoate (1 mg, i.m.) 30 h after device removal. All cows were inseminated 28 to 30 h after the second treatment with estradiol benzoate, regardless of observed estrus. Cows treated in Period 1 received inserts at 16 to 20 d postpartum and were inseminated at 25 to 29 d postpartum. Cows treated in Period 2 received inserts at 26 to 30 d postpartum and were inseminated at 35 to 39 d postpartum. Diameter of the largest follicle at insert removal was greater in cows treated in Period 2 (10.1 ± 0.3; mm ± SEM) than in cows treated in Period 1 (9.1 ± 0.3; P < .05). Diameter did not differ with the side of ovulation in respect to the previously gravid uterine horn. Diameter was greater in cows 5 to 9 (10.3 ± 0.3) than in cows 3 to 4 (9.0 ± 0.3) or 10 to 13 (9.4 ± 0.6) yr of age (P < .01). The proportion of cows that ovulated from the ovary contralateral to the previously gravid uterine horn was greater (P < .05) than of those that ovulated from the ipsilateral ovary, and the incidence of ovulation was reduced in cows 3 to 4 yr of age (P < .01). Conception rate tended to be greater for ovulation from the ipsilateral compared with the contralateral ovary, relative to the previously gravid uterine horn (P < .10) and for ovulation from the right than the left ovary (P < .06). Conception rate was less if cows ovulated a follicle that was < 9 mm than a follicle ≥ 9 mm in diameter at insert removal (P < .01) and was greater in cows inseminated in June than in April or May (P < .05). In conclusion, in cows in which estrus was synchronized at 25 to 39 d postpartum, ovulation from either the ovary ipsilateral to the previously gravid uterine horn, or the right ovary, tended to increase fertility.

Key Words: Cattle, Ovulation, Postpartum Interval, Pregnancy

Introduction

Synchronization of estrus is an essential tool for beef cattle producers to effectively use AI to introduce valuable genetic traits into a herd. Exogenous steroids have been used to synchronize estrus and to reduce the interval from parturition to conception (Foote and Hunter, 1964; Saiduddin et al., 1968). Conception rates to first service have not been consistently acceptable, especially when insemination has been at a fixed time, and have been particularly variable in cows inseminated at 25 to 40 d postpartum.

Regimens for synchronization of estrus using progesterone usually induce estrus in anestrous cows, prevent the occurrence of short luteal phases (Ramirez-Godinez et al., 1981), and thus allow the first ovulation postpartum to be potentially fertile. The hypophysial-ovarian axis is functional at 25 to 40 d after parturition (Wagner et al., 1969; Britt et al., 1974); however, incomplete uterine involution may hinder establishment of a viable pregnancy. Uterine involution involves the reduction in size of the uterine horns, sloughing of tissue, and regeneration of the uterine epithelium (Kiracofe, 1980). The entire process appears to be complete between 30 and 40 d postpartum and 10 to 15 d earlier in the

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A previously non-gravid uterine horn (Wagner and Hansen, 1969).

The first ovulation postpartum (after day 20) occurs on the ovary ipsilateral to the previously gravid uterine horn in approximately 40% of cows (Foote and Peterson, 1968; Graves et al., 1968). Therefore, ovulation from the ovary ipsilateral to the previously gravid uterine horn may reduce the first-service conception rate of cows bred at 25 to 40 days after parturition. This experiment was performed to evaluate the effect of the side of ovulation with respect to the previously gravid uterine horn on fertility of cows inseminated at 25 to 29 or 35 to 39 days postpartum, two periods during the latter stages of uterine involution.

**Materials and Methods**

The experiment was conducted in two herds with a total of 124 lactating, postpartum beef cows of mixed breeding. The cows ranged in age from 3 to 13 years and in body condition score from 3 to 7 (Richards et al., 1986). Within 3 weeks postpartum, the gravid uterine horn of the previous pregnancy was classified based on palpation of the uterus per rectum to determine the largest horn in each cow, and each cow was assigned at random to period of treatment. At the beginning of treatment, reproductive tracts were evaluated by transrectal ultrasonography to include a uterus free of infection and ovaries free of adhesions or cystic follicles.

Each cow received an intravaginal progesterone insert (InterAg Division of DEC International, Hamilton, NZ) for 7 days, estradiol benzoate (EB; 2 mg, i.m.) at the time of device insertion, prostaglandin (PG) F2α (25 mg, i.m.) at the time of device removal, and EB (1 mg, i.m.) 30 hours after device removal. Four cows lost the device during treatment. Devices were replaced with new ones in two cows in which loss was observed within 8 hours and one of these two cows completed treatment; the other lost a second device. All cows that contributed data (n = 121) were inseminated 28 to 30 hours after the second treatment with EB (58 to 60 hours after insert removal), regardless of observed estrus (determined by twice daily observation), using frozen-thawed semen from two Angus bulls of proven fertility. This regimen yielded pregnancy rates of 56% for cows > 40 days postpartum and 43% for cows 28 to 40 days postpartum at insemination in a previous study (Bridges et al., 1999).

Follicular size and the presence of corpora lutea, which would indicate ovulation before treatment, were recorded at the time of device removal by transrectal ultrasonography (Aloka 500, Corometrics Medical System, Wallingford, CT) using a 7.5-MHz transducer. Posttreatment ovulation was identified by visualization of a corpus luteum (CL) upon ultrasonography at 7 to 10 days after insemination and pregnancy was determined by ultrasonography at 30 to 40 days after insemination.

Two periods of treatment and insemination were compared. Cows in Period 1 received inserts at 16 to 20 days postpartum and were inseminated at 25 to 29 days postpartum. Cows in Period 2 received inserts at 26 to 30 days postpartum and were inseminated at 35 to 39 days postpartum.

**Statistical Analysis**

Cows were classified into three age groups (3 to 4 years, n = 53; 5 to 9 years, n = 55; and 10 to 13 years, n = 13) at insemination. There was no effect of herd within month of insemination on conception rate so data from the two herds were pooled. Effects of postpartum interval, side of ovulation (right or left) and side of ovulation relative to the previous pregnancy, month of insemination, age of cow, and body condition score on follicular size at insert removal were examined by ANOVA. Effects of the above variables and follicular size on the incidence of estrus and ovulation, and of these variables and service sire on conception and pregnancy rates were assessed using the CATMOD procedure (SAS, 1997). Data for detection of estrus and for pregnancy rate excluded one cow for which data were not recorded. Data for determination of follicular size, incidence of ovulation, and conception rate were not available for the previously mentioned cow, for one cow in which side of ovulation was not evaluated, and for one cow that had a cystic follicle at insert removal.

**Results**

**Follicular Diameter**

The diameter of the largest follicle at insert removal was greater (10.1 ± 0.3 vs. 9.1 ± 0.3; mm ± SEM) in cows treated in Period 2 compared with Period 1 (P < 0.05) but did not differ due to the side of ovulation with respect to the previously gravid uterine horn. Follicular diameter was greater in June (11.2 ± 0.6) than in April (9.4 ± 0.2) or May (9.2 ± 0.5; P < 0.01). Follicular diameter also varied with body condition score, averaging 8.8 ± 0.5, 9.4 ± 0.2, 11.2 ± 0.5, or 10.1 ± 0.4, for cows with body condition scores of 4, 5, 6, or 7, respectively (P < 0.05). The single cow with a body condition score of 3 had a 7-mm follicle at insert removal and did not ovulate. Follicular diameter was greater in cows 5 to 9 years of age (10.3 ± 0.3) than in cows 3 to 4 (9.0 ± 0.3) or 10 to 13 years of age (9.4 ± 0.6; P < 0.01).

**Detection of Behavioral Estrus**

Standing estrus was detected in 100/120 (83%) cows on the morning of the designated day of insemination. Of those cows not observed in standing estrus during the target period, 14/20 displayed signs of estrus including discharge of mucus and repeated mounting behavior. Two cows were detected in standing estrus during the afternoon of the day of insemination and four cows were not observed to display any estrous activity. Occurrence of standing estrus was not affected by postpartum period, body condition score, month of insemination, or age of cow.
Table 1. Incidence of ovulation and conception and pregnancy rates of cows inseminated at 25 to 29 d (Period 1) or 35 to 39 d (Period 2) postpartum

<table>
<thead>
<tr>
<th>Variable</th>
<th>Postpartum interval to insemination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Period 1</td>
</tr>
<tr>
<td>Incidence of ovulation&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50/59 (85%)</td>
</tr>
<tr>
<td>Conception rate&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Ovulating cows</td>
<td></td>
</tr>
<tr>
<td>Ipsilateral</td>
<td>9/21 (43%)</td>
</tr>
<tr>
<td>Contralateral</td>
<td>7/27 (26%)</td>
</tr>
<tr>
<td>Total</td>
<td>17/58 (30%)</td>
</tr>
<tr>
<td>Pregnancy rate&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0/10</td>
</tr>
</tbody>
</table>

<sup>a</sup>Data for incidence of ovulation and conception rate did not include two cows in which these variables were not evaluated and one cow with a cystic follicle at insert removal. Conception rate tended to increase with ovulation from the ovary ipsilateral to the previously gravid uterine horn (P < .01).

<sup>b</sup>Pregnancy rate excluded one cow that was not evaluated.

Incidence of Ovulation

The incidence of ovulation before treatment was 6/120 (5%). One cow had a cystic follicle measuring 30 mm in diameter and was excluded from analysis; the other five cows were included in the study. The incidence of ovulation after treatment was not affected by the postpartum period, with 50/59 (85%) cows ovulating in each treatment period (Table 1). The incidence of ovulation was greater from the ovary contralateral to the previously gravid uterine horn (P < .05; Table 2) and tended to be greater in cows inseminated in June (17/17; 100%) than in April (68/81; 84%) or May (15/21; 71%; P < .06). The incidence of ovulation was greater in cows with follicles 9 to 12 (68/73; 93%) or 13 to 16 (13/13; 100%) mm in diameter at insert removal, than in cows with follicles < 9 (19/32; 63%) mm in diameter (P < .01). The incidence of ovulation was greater in cows 5 to 9 (51/54; 94%) or 10 to 13 yr of age (11/11; 100%), than in cows 3 to 4 yr of age (38/53; 72%; P < .01). The incidence of ovulation was not affected by body condition score.

Conception and Pregnancy Rates

Conception rate (defined as the proportion of cows that completed treatment and ovulated that were diagnosed pregnant) and pregnancy rate (defined as the proportion of cows that completed treatment that were diagnosed pregnant) were not affected by the postpartum period (Table 1). Conception rate was not reduced when the cow ovulated from the ovary ipsilateral to the previously gravid uterine horn. In fact, there was a tendency for conception rate to be greater after ovulation ipsilateral to the previously gravid uterine horn (P < .10; Table 1). Also, conception rate tended to be greater after ovulation from the right than from the left ovary (P < .06; Table 2). Conception rate was greater in cows that ovulated a follicle of 9 to 12 (25/68; 37%) or 13 to 16 (4/13; 31%) mm in diameter at insert removal than in cows that ovulated a follicle that was < 9 mm (1/19; 5%) in diameter at insert removal (P < .01). Conception rate was greater in cows inseminated in June (10/17; 59%) than in cows inseminated in April (16/68; 24%) or May (4/15; 27%), respectively (P < .05). Conception rate was greater in cows with a body condition score of 7 (5/5; 100%) than in cows with body condition scores of 4 (1/18, 6%), 5 (18/67, 27%), or 6 (5/23, 22%), respectively (P < .01). Conception rate was not affected by the service sire or age of cow.

Discussion

Uterine involution is usually regarded as the barrier to early postpartum conception (Kiracofe, 1980). However, the postpartum interval to insemination did not affect conception or pregnancy rates in this study. Uterine involution appears to require 30 to 40 d (Wagner and Hansel, 1969), although an interval of 40 to 60 d has been reported for complete regression of the caruncles (Gier and Marion, 1968). Uterine involution progressed more rapidly in the uterine horn that was not previously gravid and the longest interval was required in the area adjacent to the previous fetus (Gier and Marion, 1968).

The present data revealed a tendency for conception rate to be greater when the cow ovulated from the ovary ipsilateral to the previously gravid uterine horn (P < .10). Although uterine involution requires more time in the previously gravid uterine horn, Perkins and Kidder (1963) reported conception rates to first service (at spontaneous estrus before 39 d postpartum) of 42 and 29% in beef cows in which the uterus had not involuted and involuted, respectively. Their data did not define the horn of the previous pregnancy but may reflect the same physiological status as the present observation of an
apparent greater fertility from oocytes entering the previously gravid uterine horn. Greater fertility also has been reported in ewes after intrauterine insemination at the uterotubal junction adjacent to the previously gravid than the previously nongravid uterine horn (Akinbami et al., 1996). However, in ewes induced into estrus 31 or 32 d postpartum, fertilization and conception rates were greater after intrauterine insemination near the uterotubal junction than after natural mating (Warren et al., 1989). The latter authors suggested that a detrimental uterine environment or a change in sperm transport restricted early postpartum conception. Foote and Peterson (1968) found no effect of the side of ovulation with respect to the previously gravid uterine horn or extent of uterine involution on conception rate to first service in beef cows. This contrasting result may be due to the limited number of cows available to differences in ovulation and conception after the spontaneous occurrence of estrus compared with ovulation induced in anestrous cows by treatment with progesterone and estradiol benzoate.

The previous pregnancy had occurred in the right uterine horn in 69% of 121 cows placed on this experiment and the current pregnancy was in the right uterine horn in 66% of 29 cows diagnosed pregnant after a single ovulation. These proportions agree with Clark (1936) and with data from the Director’s Report (1931) in which 58% of 704 and 64% of 146 pregnancies, respectively, were in the right uterine horn. The right ovary ovulates more frequently and has been termed more functional in cattle (Reece and Turner, 1938), and, in this study, the incidence of ovulation from the ovary contralateral to the previous pregnancy was greatest when the previous pregnancy was in the left uterine horn. However, cows ovulated with equal frequency on each ovary during the study, which does not account for the apparent greater frequency of the current pregnancy in the right uterine horn. Instead, conception rate tended to be greater when the cow ovulated from the right ovary ($P < .06$). Given that more ovulations occurred contralateral to the previous pregnancy and that conception rate tended to be greater after ovulation from the right ovary, differences in pregnancy rate between right and left are apparently due to greater fertility in the right oviduct and(or) uterine horn in the early postpartum cow.

Conception rate was reduced from 27 and 22% in cows with body condition scores of 5 and 6, respectively, to 6% in cows with a body condition score of 4. A longer duration of postpartum anestrus and greater number of days to pregnancy were reported in cows with a body condition score at calving of $\leq 4$ vs $\geq 5$ (Richards et al., 1986). Likewise, the duration of postpartum anestrus and pregnancy rate were affected by pre- and postpartum weight changes (Dunn and Kaltenbach, 1980; Houghton et al., 1990). Growth rate of follicles and peripheral concentrations of LH and IGF-I were reduced, and the ability of the pituitary to release LH in response to exogenous GnRH was increased (Whisnant et al., 1985, Bossis et al., 1999) by treatments designed to induce nutritional anestrus. In the present experiment, body condition was evaluated once, midway through the experiment. Follicular diameter at insert removal was greater in cows with body condition scores of 6 or 7; frequencies of ovulation and conception were greater in cows bearing follicles $\geq 9$ mm in diameter at insert removal. Evaluation of body condition score at different stages of the experiment might have allowed further interpretation of the effects of nutritional status on follicular size, ovulation, and conception rate.

Follicular diameter at insert removal, the incidence of ovulation, and conception rate were greater in cows inseminated in June than in those inseminated in April or May. Thibault et al. (1966) reported seasonal effects on the interval of postpartum anestrus and on fertility in cattle that were due to photoperiod rather than to nutrition or temperature. Artificial reversal of photoperiod did not appear to alter amplitude and duration of endogenous surges of LH and FSH in heifers (Rzepkowski, 1982), but changes in photoperiod were reported to alter diurnal patterns of secretion of melatonin and gonadotropins in steroid-treated ovarioctomized heifers (Critser et al., 1988). The effect of photoperiod on reproduction is more apparent in seasonal breeders, such as sheep; however, conception rates in cattle were correlated positively with hours of daylight (Mercier and Salisbury, 1947). Alternatively, the availability of some grass pasture in the experimental lots on one farm may have improved reproductive performance as the season progressed. On the other farm, cows were in gravel lots and were fed the same rations throughout the experiment.

In summary, pregnancy was established in some cows inseminated as early as 25 to 29 d postpartum. Ovulation after treatment with progesterone and estradiol benzoate occurred with equal frequency on either ovary. However, there was a tendency for conception rate to be greater in cows that ovulated from the right ovary. Conception rate was not reduced but rather tended to be greater for ovulation from the ovary ipsilateral to the previously gravid uterine horn.

**Implications**

Insemination as early as 25 to 29 d postpartum did not appear to restrict conception rate more than insemination at 35 to 39 d postpartum. Conception rates were higher in cows in good body condition that had been exposed to favorable environmental conditions, regardless of stage postpartum. Ovulation from the ovary ipsilateral to the previously gravid uterine horn did not reduce conception rate; thus, the previously gravid uterine horn cannot be held accountable for lower conception rates in cows induced to show estrus and ovulate early in the postpartum period.

**Literature Cited**


Director’s Report. 1931. Work and progress of the Agricultural Experiment Station. Idaho Agricultural Experiment Station Bulletin 179, Moscow, Idaho.


