EFFECTS OF INTRAVAGINAL PROGESTERONE ON PREGNANCY AND SYNCHRONIZATION RATES IN BEEF CATTLE

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Story in Brief

Controlled internal drug release-bovine (CIDR-B) devices were inserted into the vagina of 25 crossbred beef cows between days 6 to 8 post-insemination and removed 15 days following CIDR-B insertion. Twenty-two control cows did not receive CIDR-B devices. Ten randomly selected cows from each group were bled by coccygeal venipuncture at 0, 6, 12 and 24 hours following CIDR-B insertion. An additional sample was obtained immediately following the removal of the CIDR-B device on Day 22 post-insemination. Serum samples were analyzed for progesterone content. Approximately 50 days post-insemination, all cows were rectally palpated to confirm pregnancy. Pregnancy rate was not significantly improved by progesterone supplementation. Cows that received a CIDR-B device showed an increase in plasma progesterone concentrations between 0 and 12 hours following CIDR-B insertion. Estrus expression in cows not settling to artificial insemination ranged from 48 to 54 hours following CIDR-B removal. In the control group, nonpregnant cows returned to estrus from 20 to 25 days post-insemination.

(Key Words: Cows, Progesterone, Pregnancy.)

Introduction

In the pregnant cow, there is some evidence that plasma progesterone concentrations are elevated over cycling cows (Robinson et al., 1989). It has been suggested that a viable embryo enhances progesterone production as early

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as day ten of gestation. However, there are many other studies which have not indicated a difference in plasma progesteorne between cyclic and pregnant cows. Because insufficient progesterone levels have been implicated as a possible cause of early embryonic mortality, various attempts have been made to improve pregnancy rates through the use of exogenous progesterone supplementation. Currently, the evidence is unclear as to the exact time of the estrous cycle in which exogenous progesterone may or may not increase embryonic survival.

In cattle, the timing of estrus is controlled by secretion of progesterone from the corpus luteum. Progesterone causes a negative feedback on luteinizing hormone (LH) secretion which inhibits growth of preovulatory follicles and their subsequent ovulation until progesterone declines at the time of CL regression.

Exogenous progestogens can be used to synchronize estrous cycles in cattle and induce estrus and ovulation in prepubertal heifers and anestrous cows. In most production systems it would be advantageous to have cattle synchronized not only for the initial artificial insemination (AI) but subsequent rebreeding 21 days later. Recent research efforts have focused on supplementing cattle with intravaginal progesterone to try to improve pregnancy rates and to study the return to estrus patterns in synchronized cattle (Macmillan et al., 1990). Plasma progesterone concentrations can be increased by three to five ng/ml in cows treated with progesterone releasing devices (Munro, 1989). This practice may elevate plasma progesterone concentrations so that embryonic mortality is reduced and pregnancy rates are increased. Although there is evidence that supplementing progesterone with controlled internal drug release-bovine (CIDR-B) devices increases pregnancy rates in dairy cattle, little is known of its application to beef cattle in range conditions. Investigation of the beneficial affects of CIDR-B administration on pregnancy rate and synchronized estrus following nonfertile AI could have practical applications for the beef producers in southwestern states. Therefore, the objectives of the present study were to: 1) determine if exogenous progesterone administration increases pregnancy rates in multiparous range cows, and, 2) determine if estrus is synchronized in cows not conceiving to the initial breeding.

Materials and Methods

Eighty lactating beef cows of either Hereford x Angus or ¼-Brahman (¼-Brahman x ¼-Hereford x ½-Angus or ¼-Brahman x ¼-Angus x ½-Hereford) crossbreeding were synchronized by two single injections of 25 mg of prostaglandin F2α (Lutalyse; Upjohn, Kalamazoo, MI) administered

intramuscularly to each animal, eleven days apart. Following the second Lutalyse injection, the cows' tail heads were marked with a paintstick and cows were exposed to a vasectomized, penile deviated bull equipped with a chin-ball marker to aid in estrous detection. Subsequent to the second Lutalyse injection, all cows were observed daily for signs of estrus at 0800 and 1700 h. Cows that were either observed standing while mounted by another animal, had chalk rubbed off their tail head, or were marked by sterile bulls equipped with chin-ball markers were considered to be in estrus.

Of the 80 cows treated with Lutalyse, 47 cows responded to treatment and were in estrus within 3 to 5 days following the second injection. The 47 cows utilized for A.I. ranged from 28 to 72 days postpartum (mean = 56.0 $\pm$ 8.8 d) at the initiation of the study. The average body condition score of the animals used in the study was 5.3 $\pm$ .5 (1 = emaciated and 9 = obese). Animals were maintained on native grass pasture and fed prairie hay ad libitum throughout the study. Prior to the study, cows were fed supplemental protein during the winter months. On April 1, 1990 approximately thirty days prior to the initiation of the breeding season, cows were changed from a supplemental protein source to supplemental energy source of cracked corn fed at 1.82 kg/hd/day.

Cows were inseminated 12 hours after observed estrus. Cows were randomized to be inseminated by two technicians. Service sires were randomly assigned to each cow before initiation of the breeding season. Following insemination, each cow was randomly assigned to a treatment (CIDR-B) or a control (CONTROL) group. Cows assigned to the treatment group had a CIDR-B device inserted into the vagina using a CIDR-B applicator dipped into lubricant before insertion between days 6 and 8 post-insemination (mean = day 7). The CONTROL group received no CIDR-B device. All CIDR-B devices were removed 15 days following insertion. Cows were monitored daily for return to estrus. Approximately 50 days post-insemination, all animals were rectally palpated to confirm pregnancy.

Ten cows from each treatment group were randomly selected and blood samples were collected by coccygeal venipuncture into evacuated non-heparinized tubes. Samples were collected at 0, 6, 12 and 24 hours following CIDR-B insertion. An additional sample was collected at the time of CIDR-B removal from both treatment groups on day 22. Serum was assayed for progesterone content.

Treatment effects on conception rate and content of progesterone in plasma at the time of CIDR-B removal were analyzed by Chi-square. Concentrations of progesterone in plasma of samples collected at 0, 6, 12 and 24 hours after CIDR-B insertion were analyzed by split-plot analyses of variance with CIDR-B treatment as the main plot and time as sub-plot plus interactions.

Results and Discussion

There was no significant treatment difference in pregnancy rate of CONTROL (68.2%) and CIDR-B (72.0%) cows (Table 1).

The concentration of progesterone in plasma of ten CONTROL and CIDR-B cows at 0, 6, 12 and 24 hours following time of CIDR-B insertion is presented in Figure 1. Progesterone concentrations increased ($P < .07$) by 4.26 ng/ml between 0 and 12 hours and then decreased ($P < .07$) by 3.81 ng/ml between 12 and 24 hours following CIDR-B insertion. In contrast, progesterone concentrations did not significantly change with time in CONTROL cows.

Of the seven CIDR-B animals that were nonpregnant to the first AI service, three were observed in estrus at 48 hours followed by three additional cows at 54 hours after CIDR-B removal. The remaining cow was not observed in estrus during the 7 day heat detection period following CIDR-B removal. In the nonpregnant CONTROL animals, return to estrus ranged from 20 to 25 days post-insemination.

Conception rates in cows have been improved by progesterone supplementation by means of intravaginal devices, if treatment is initiated no earlier than five days post-insemination (Robinson et al., 1989; Macmillan et al., 1990). In the present experiment, however, a 15 day administration of the CIDR-B device commencing on days 6 to 8 post-insemination did not affect pregnancy rates over untreated CONTROLS. These results agree with a larger study which did not show a significant increase in pregnancy rates of heifers treated with the CIDR-B device (VanCleff, 1991). The increase in conception rate in the present study was only slightly positive (3.8%), substantially less than the 30% increase in pregnancy rates observed by Robinson et al,. (1989) and a 13.5% increase in dairy cows observed by Macmillan et al., (1990). Exogenous progesterone supplementation may be more beneficial in cows which are rendered less fertile by the demands of lactation, effects of previous pregnancies or disease, than in normally fertile heifers (VanCleff, 1991).

Table. 1. Pregnancy rates in control cows (CONTROL) and those treated with progesterone (CIDR-B)

Treatment	N	Pregnant	Nonpregnant	Conception Rate
CONTROL	22	15	7	68.2%
CIDR-B[a]	25	18	7	72.0%

[a]CIDR-B = Controlled Internal Drug Release-Bovine

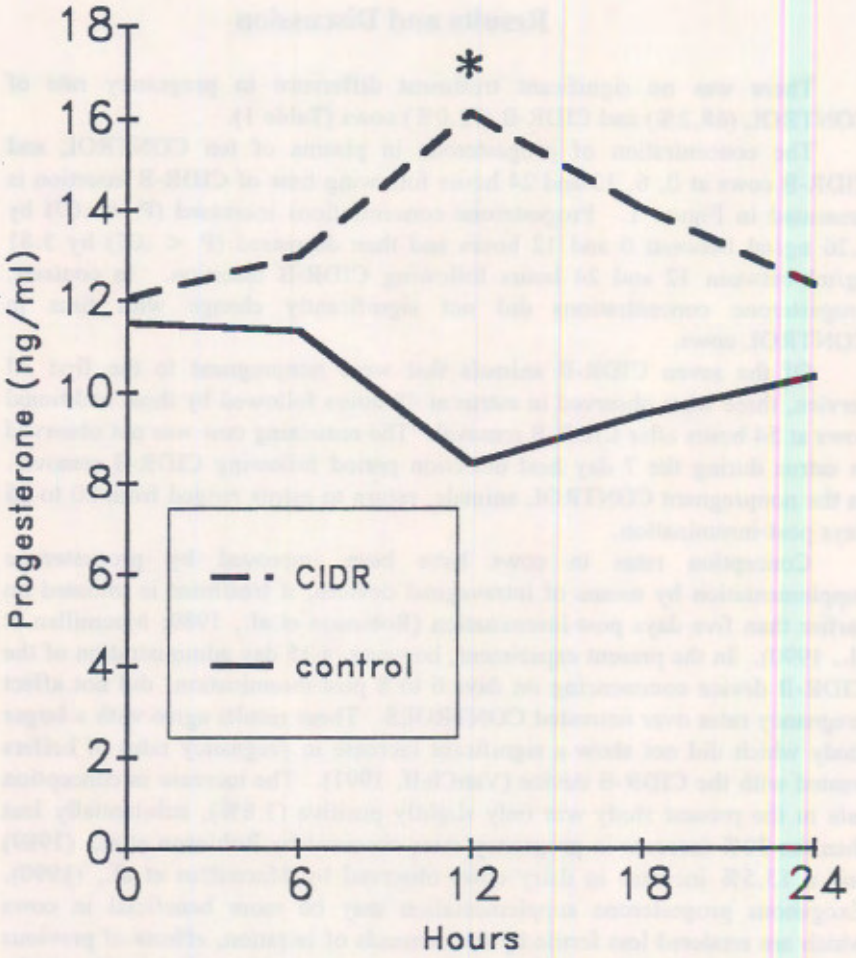

FIGURE 1. Serum progesterone concentrations in CONTROL (solid line) and treatment cows (dashed line) at 0, 6, 12 and 24 hours after CIDR-B insertion. Asterisk (*) indicates mean differs from 0 hour treated mean ($P < .07$).

However, because pregnancy rates of lactating cows were not altered in the present study, the benefits of supplemental progesterone, if any, are still unclear.

The remaining objective of this study was to evaluate the efficacy of progesterone supplementation in synchronizing the return to estrus of cows which did not maintain pregnancy past day 20. Although the number of cows returning to heat was small, removal of the CIDR-B device provided a tight synchrony in the return estrus. All treated cows that returned to estrus, did so within a 6 hour period which was between 48 and 54 hours after CIDR-B removal. Of the seven CONTROL animals that returned to estrus, 3 (42.9%) were confirmed pregnant to the second AI service, whereas, only 1 of 6 (16.7%) CIDR-B treated animals were confirmed pregnant to the second insemination. It has been demonstrated that exogenous progesterone alters both CL lifespan and plasma concentrations of progesterone (Robinson et al., 1989). The reduced conception rates at the return to service following intravaginal progesterone supplementation may be similar to results seen using an orally active progestogen, such as melengestrol acetate, for a long treatment period. Numerous factors may be responsible for the reduced fertility following long-term progestogen treatment, most of which are not clearly understood.

In summary, the present study did not demonstrate an enhancement of fertility with CIDR-B devices in crossbred beef cows. Therefore, at this time it is questionable to justify the recommendation of such treatment in routine reproductive management of beef cows which have normal fertility. Currently, CIDR-B devices are not approved for use in the United States; however, their approval is expected in the near future. If CIDR-B devices are approved in the U.S., information from studies in other countries as well as experimental data from the U.S. justifies further research into developing synchronization programs using supplemental progestogens. Further investigation is needed to determine the mechanisms by which exogenous progesterone administration may enhance conception rate in beef herds which have suboptimal fertility.

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