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Treatment of Cycling and Noncycling Lactating Dairy Cows with Progesterone During Ovsynch[1]

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ABSTRACT

Our objective was to determine whether progesterone (P4) supplementation during an Ovsynch protocol would enhance fertility in lactating dairy cows. Lactating dairy cows (n = 634) at 6 locations were assigned randomly within lactation number and stage of lactation to receive the Ovsynch protocol [OVS; synchronization of ovulation by injecting GnRH 7 d before and 48 h after $PGF_{2\alpha}$, followed by one fixed-time AI (TAI) 16 to 20 h after the second GnRH injection] or Ovsynch plus a controlled internal drug release (CIDR) P4-releasing insert for 7 d, beginning at the first GnRH injection (OVS + CIDR). Blood was sampled to quantify P4 10 d before the first GnRH injection, immediately before the first GnRH injection, at the time of CIDR removal, before the $PGF_{2\alpha}$ injection (1 to 2 h after CIDR insert removal), and 48 h after the $PGF_{2\alpha}$ injection to determine cyclicity status before initiation of treatment, luteal status at the $PGF_{2\alpha}$ injection, and incidence of luteal regression. Overall, conception rates at 28 (40 vs. 50%) and 56 d (33 vs. 38%) after TAI differed between OVS and OVS + CIDR, respectively; but a treatment × location interaction was detected. Compared with OVS, pregnancy outcomes were more positive for OVS + CIDR cows at 4 of 6 locations 28 d after TAI and at 3 of 6 locations 56 d after TAI. An interaction of luteal status (high vs. low) before CIDR insert removal and $PGF_{2\alpha}$ injection with pretreatment cycling status indicated that cows having low P4 at $PGF_{2\alpha}$ injection benefited most from P4 supplementation (OVS + CIDR = 36% vs. OVS = 18%), regardless of pretreatment cycling status. Pregnancy loss between 28 and 56 d after TAI was greater for noncycling cows (31%) compared with cycling cows (16%). Pregnancy loss for cows receiving P4 (21%) did not differ from that for cows not receiving P4 (21%). Supplementation of P4, pretreatment cycling status, and luteal status before $PGF_{2\alpha}$ injection altered follicular diameters at the time of the second GnRH injection, but were unrelated to pregnancy outcomes. Incidence of multiple ovulation was greater in noncycling than in cycling cows. Further, cows having multiple ovulations had improved pregnancy outcomes at 28 and 56 d after TAI. In summary, a CIDR insert during the Ovsynch protocol increased fertility in lactating cows having low serum P4 before $PGF_{2\alpha}$ injection. Improved pregnancy outcomes were observed at some, but not all locations.

Key words: controlled internal drug release, Ovsynch, dairy cow, fertility

INTRODUCTION

Poor conception rate in lactating dairy cows ranks as one of the most limiting factors to dairy profitability. Conception rates decreased from 66% in 1951, to 50% during 1973 to 1985 (Butler and Smith, 1989), to about 45% for cows inseminated at spontaneous estrus and 35% for cows receiving a timed AI (**TAI**) in 2000 (Lucy, 2001). This decrease in fertility was concurrent with a dramatic increase in DMI and milk production per cow.

A negative relationship exists between DMI and circulating concentrations of progesterone (**P4**) in lactating dairy cows (Sangsritavong et al., 2002); and lactating dairy cows have serum concentrations of P4 less than those in nonlactating nulliparous heifers (Wiltbank et al., 2000; Wolfenson et al., 2004). Progesterone is important to fertility as demonstrated by a positive correlation between serum P4 before AI and subsequent conception rate (Fonseca et al., 1983; Folman et al., 1990).

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Several studies have examined the effect of exogenous progestin supplementation on fertility in lactating dairy cows. Conception rate was greater for cows that received a P4-releasing intravaginal device during 7 d before the second of 2 injections of $PGF_{2\alpha}$ (14 d between injections), compared with controls (Folman et al., 1990). Decreased conception rates, however, were reported in lactating dairy cows and heifers without a corpus luteum (**CL**) at the end of treatments with P4 or norgestomet, compared with females having a CL at the end of progestin treatment (Smith and Stevenson, 1995).

Combining progestin treatments with protocols similar to Ovsynch (synchronization of ovulation by injecting GnRH 7 d before and 48 h after $PGF_{2\alpha}$ followed by one fixed-time AI 16 h after the second GnRH injection) administered to noncycling suckled beef cows improved conception rates resulting from inseminations after estrus or those resulting from TAI (Lamb et al., 2001; Stevenson et al., 2003). Similar studies in lactating dairy cows reported improved conception rates in first-lactation cows treated with intravaginally placed P4-releasing controlled internal drug release (**CIDR**) inserts during an Ovsynch protocol (experiment 1; El-Zarkouny et al., 2004; Moreira et al., 2004a) and in all cows treated with CIDR inserts during an Ovsynch protocol in which estrous cycles were presynchronized (**Presynch;** Moreira et al., 2004b). In contrast, no positive effects of the P4 via the CIDR insert were detected in another study in which cows were treated with Presynch + Ovsynch (experiment 2; El-Zarkouny et al., 2004).

The current experiment was designed to test the hypothesis that providing P4 (via a CIDR insert) during Ovsynch before TAI would improve fertility, particularly in noncycling cows and those having no CL at the time of $PGF_{2\alpha}$ injection. Specifically, our objective was to determine whether P4 administration before induced luteal regression might improve overall fertility by either increasing conception rates or reducing pregnancy losses in lactating dairy cows determined retrospectively to be cycling or noncycling before the onset of treatment.

MATERIALS AND METHODS

Experimental Locations

This study was a collaborative project of the North Central Regional Research Project 113 of the Cooperative States Research, Education, and Extension Service (CSREES). Similar treatments were applied to lactating Holstein cows in 6 locations (Illinois, Kansas, Michigan, Missouri, Ohio, and Wisconsin) in which coauthors were located. A total of 634 cows were enrolled between December 1998 and June 1999. A similar experimental design was used at each location. Cows were organized into breeding clusters in which they were inseminated on the same day in each particular breeding cluster. Details, variations in data collection, and methodologies for each location are listed below.

Illinois. Lactating cows enrolled at this location were part of the University of Illinois research herd composed of 200 Holstein cows, with an annual rolling herd average of 9,500 kg of milk. Cows were housed in stanchions and were milked twice daily. The experiment was conducted in 96 cows organized in 5 breeding clusters in which cows were inseminated between February and May 1998. Although DIM in all cows ranged from 60 to 396 at TAI, 58 of the 96 cows were inseminated before 100 DIM.

Ultrasonography was conducted by using a transrectal 5.0-MHz linear-array transducer (Aloka 500V; Corometrics Medical Systems, Inc., Wallingford, CT). Serum P_4 concentrations were quantified by enzyme immunoassay (Kesler et al., 1990), with intra- and interassay coefficients of variation of 5 to 10%.

Kansas. Lactating cows were enrolled on a commercial dairy farm in northeastern Kansas. The herd consisted of 500 Holstein cows, with an annual rolling herd average of 11,500 kg of milk. Cows were milked thrice daily and fed a TMR consisting of chopped alfalfa, corn silage, whole cottonseed, and a concentrate-mineral mix (offered twice daily) to meet or exceed NRC (1989) recommendations for lactating cows. Cows had access to fresh water ad libitum at 3 locations in each 100-cow pen, which consisted of feed-line self-locking head gates and free stalls bedded with sand. All procedures, including hormone injections, blood collection, TAI, and ovarian ultrasonography, were conducted while cows were locked up at the feed line after the morning milking. The experiment was conducted in 184 cows organized in 8 breeding clusters in which cows were inseminated between January and June 1999. All cows were inseminated at first service between 50 and 77 DIM. Some of these results were reported earlier (El-Zarkouny et al., 2004).

Ultrasonography was conducted by using a transrectal 5.0-MHz linear-array transducer (Aloka 500V; Corometrics Medical Systems, Inc.). Serum P_4 concentrations were quantified by radioimmunoassay (Skaggs et al., 1986) with intra- and interassay coefficients of variation of 6.9 and 6.4%, respectively.

Michigan. Lactating cows were enrolled at a commercial dairy farm composed of 750 Holstein cows, with an annual rolling herd average of 12,720 kg of milk. Cows were housed in freestall barns, fed a TMR balanced for milk production, and milked thrice daily. The experiment was conducted in 94 cows organized in 4